FIG.1

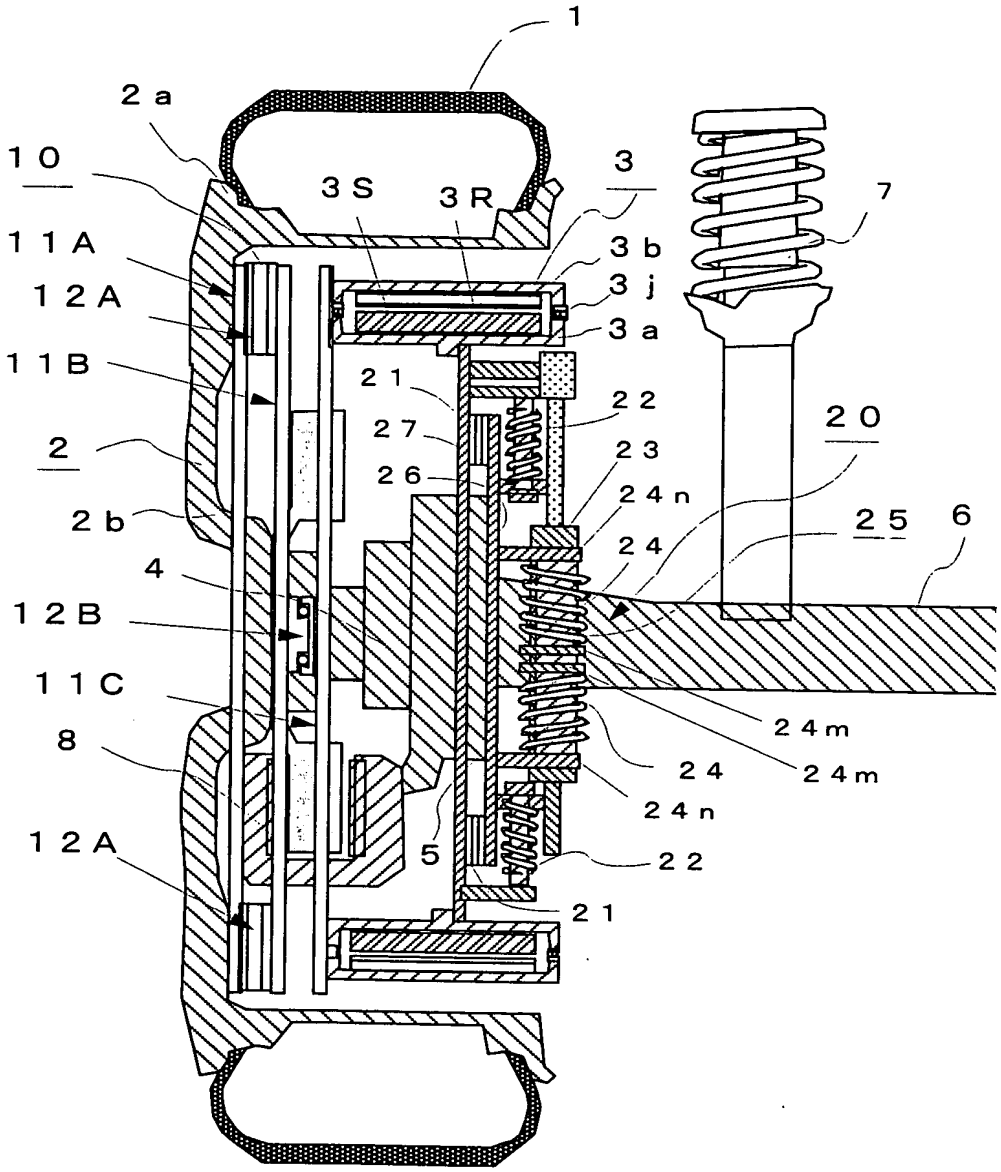

1
2a
10
3S
3R
3
7
11A
3b
12A
3j
3a
11B
21
22
20
27
2
23
26
24n
25
6
2b
24
4
12B
11C
24m
24
24m
8
24n
12A
5
22
21

FIG.2

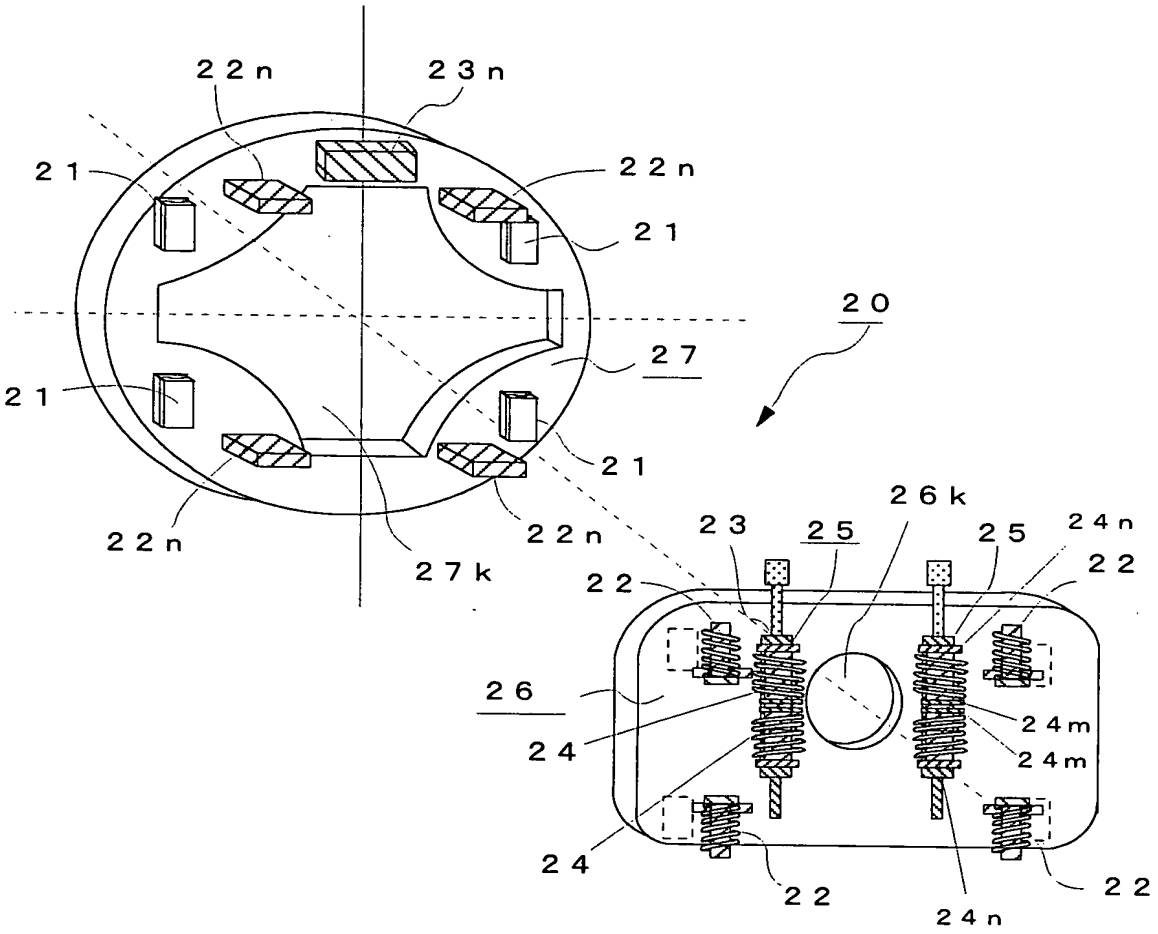

22n
23n
21
22n
21
20
27
21
21
22n
22n
27k
26k
23
25
25
24n
22
22
26
24
24m
24m
24
22
22
24n

FIG.3

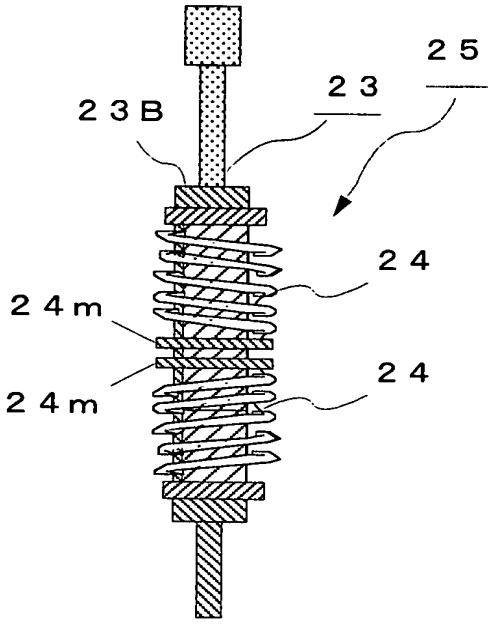


FIG.4

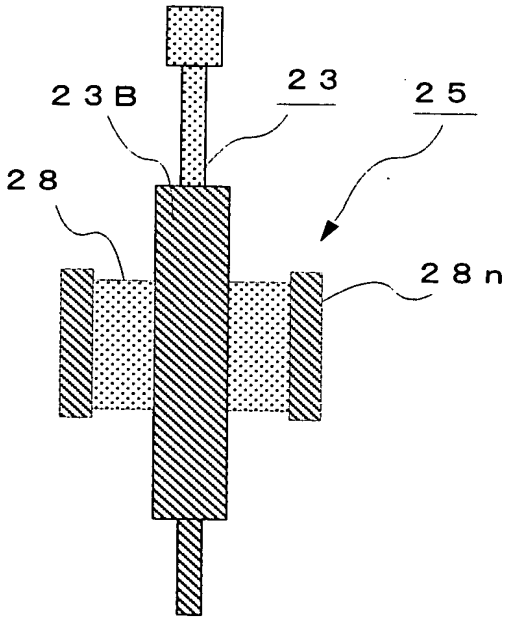


FIG.5(a)

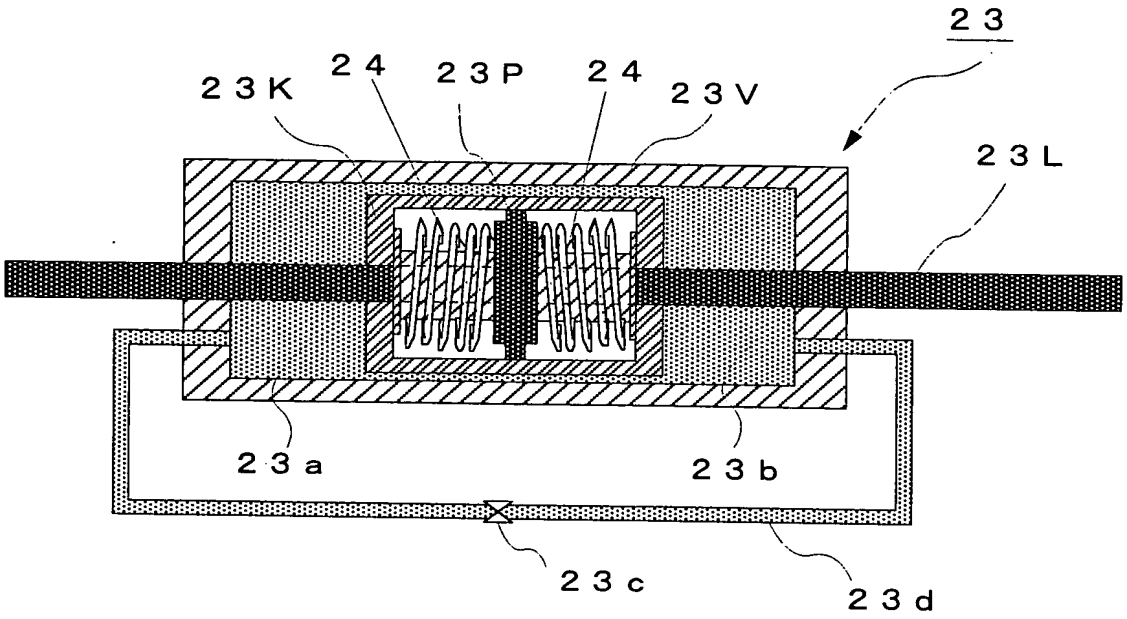
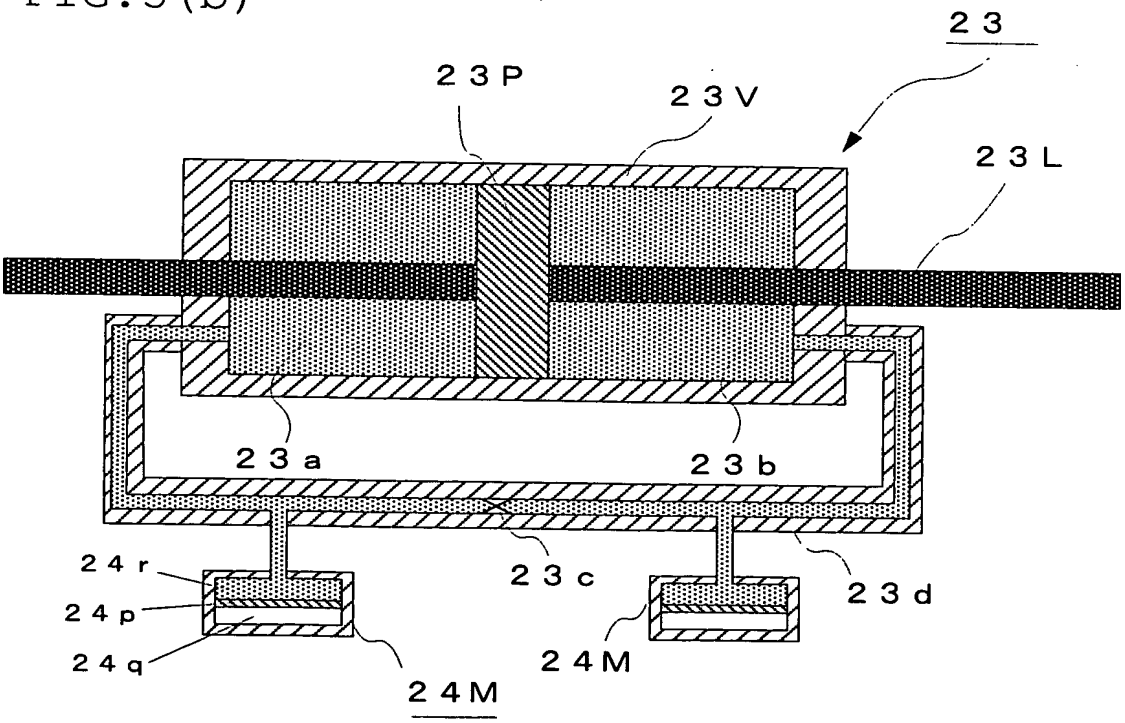

23
23K
24
23P
24
23V
23L
23a
23b
23c
23d

FIG.5(b)


23
23P
23V
23L
23a
23b
24r
24p
24q
23c
23d
24M
24M

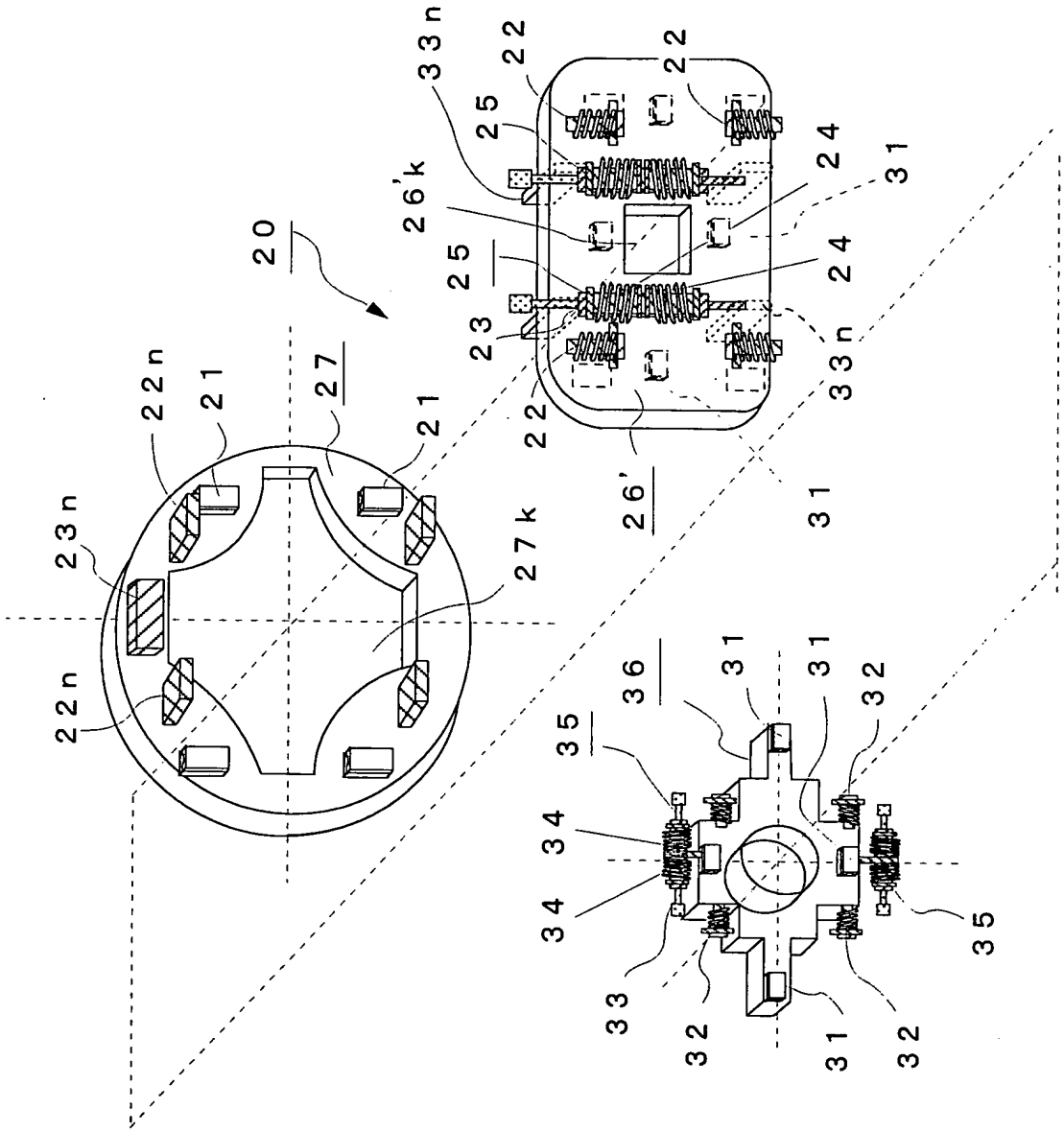


FIG.6

FIG.7

	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2	COMPARATIVE EXAMPLE 3	COMPARATIVE EXAMPLE 4	EXAMPLE 1	EXAMPLE 2	EXAMPLE 3
TYPE	CAR MOUNTED	I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM
k4 EQUIVALENT SPRING	—	—	—	—	+ SPRING ELEMENT	+ SPRING ELEMENT	+ SPRING ELEMENT
m4 EQUIVALENT MASS	—	—	—	—	—	CYLINDER ADDED TO m4	CYLINDER ADDED TO m4
DYNAMIC DAMPER PORTION				k3 STRONG SPRING	C3 CHANGED	C3 CHANGED	C3, k3 CHANGED
MOTOR(kg)	30	30	30	30	30	30	30
FRAME DRESS-UP PART(kg)	40	40	45	45	45	40	40
DAMPER MASS(kg)	—	—	30	30	30	30	30
m1 (kg)	40	70	45	45	45	40	40
m2 (kg)	370	340	340	340	340	340	340
m3 (kg)	—	—	30	30	30	30	30
m4 (kg)	—	—	—	—	—	5	5
k1 (N/m)	360000	360000	360000	360000	360000	360000	360000
k2 (N/m)	32000	32000	32000	32000	32000	32000	32000
k3 (N/m)	—	—	41000	90000	41000	41000	27000
k4 (N/m)	—	—	—	—	110000	110000	110000
c1 (N/(m/s))	50	50	50	50	50	50	50
c2 (N/(m/s))	1500	1500	1500	1500	1500	1500	1500
c3 (N/(m/s))	—	—	1000	1000	600	600	800

FIG.8(a) PRIOR ART

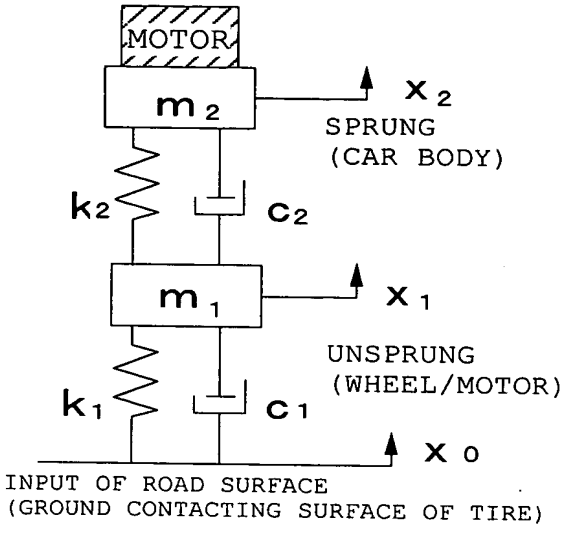


FIG.8(b) PRIOR ART

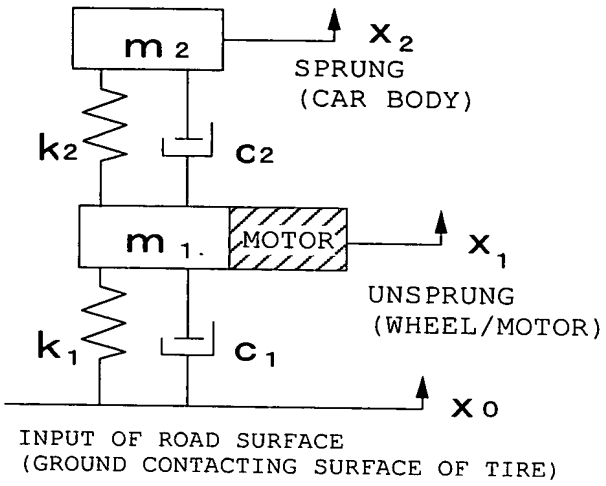


FIG.9 PRIOR ART

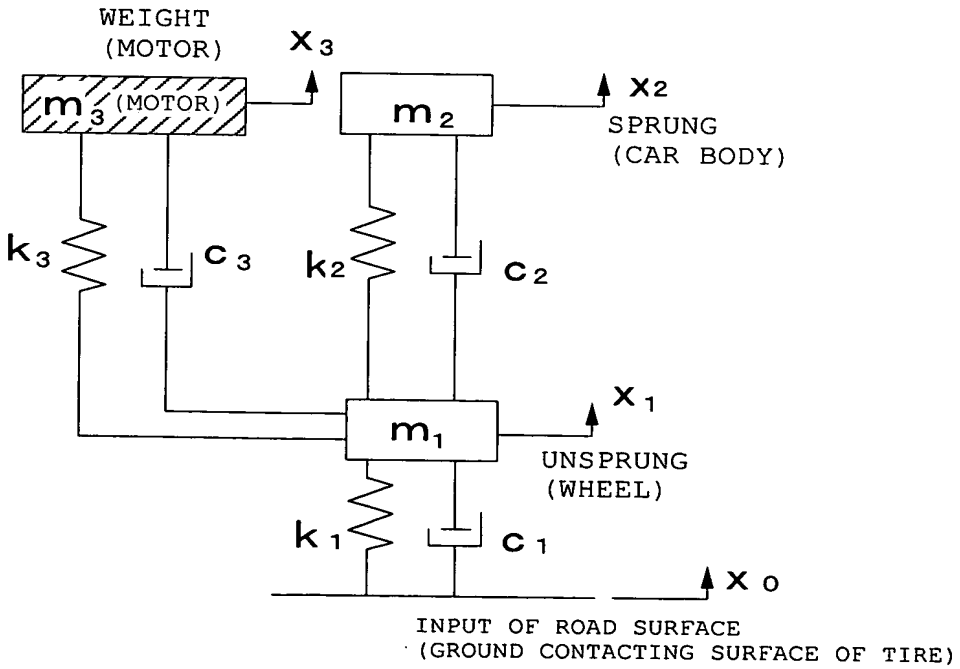


FIG.10

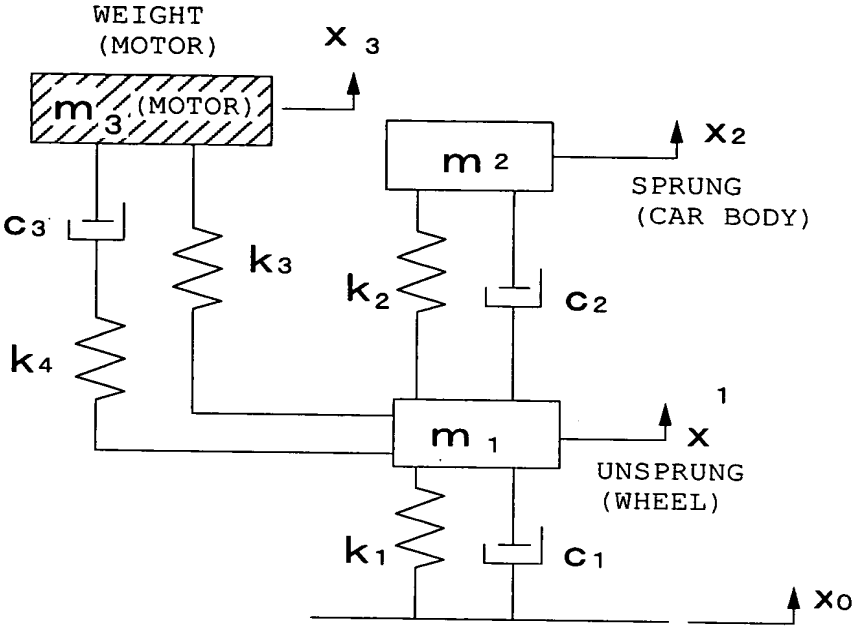

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
m 2
x2
SPRUNG
(CAR BODY)
c3
k3
k2
c2
k4
m 1
x 1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.11

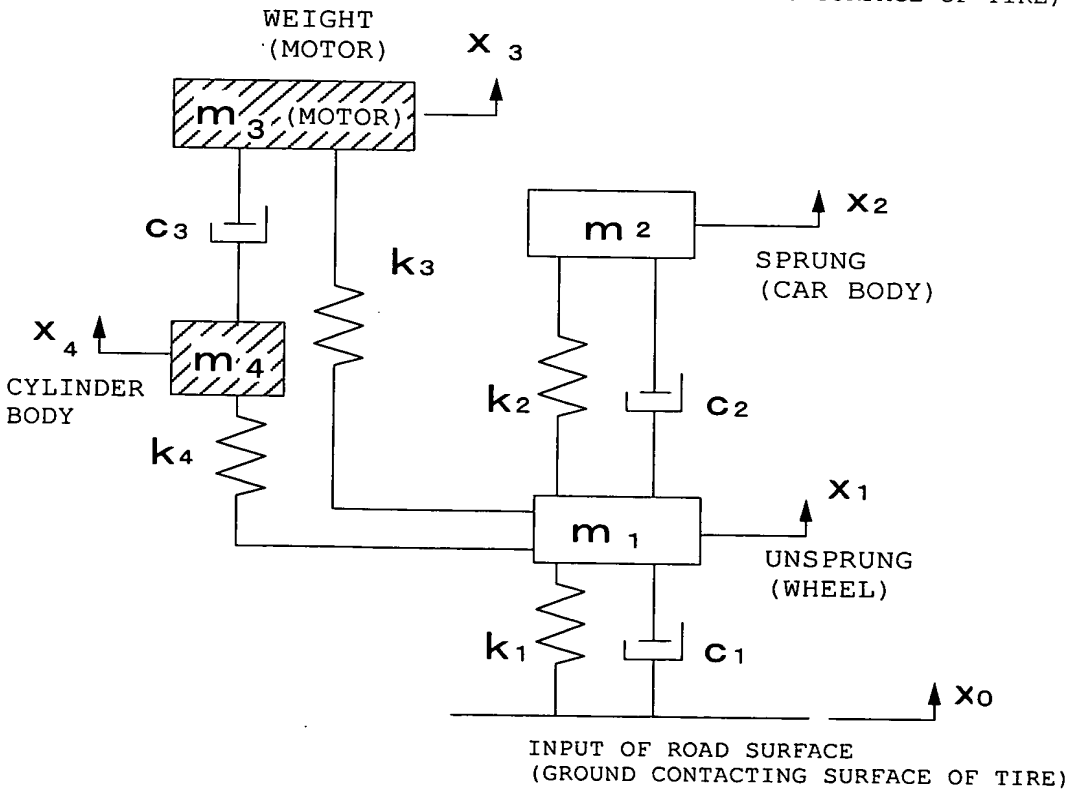

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
m 2
x2
SPRUNG
(CAR BODY)
c3
k3
x 4
m 4
CYLINDER
BODY
k2
c2
k4
x1
m 1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.12

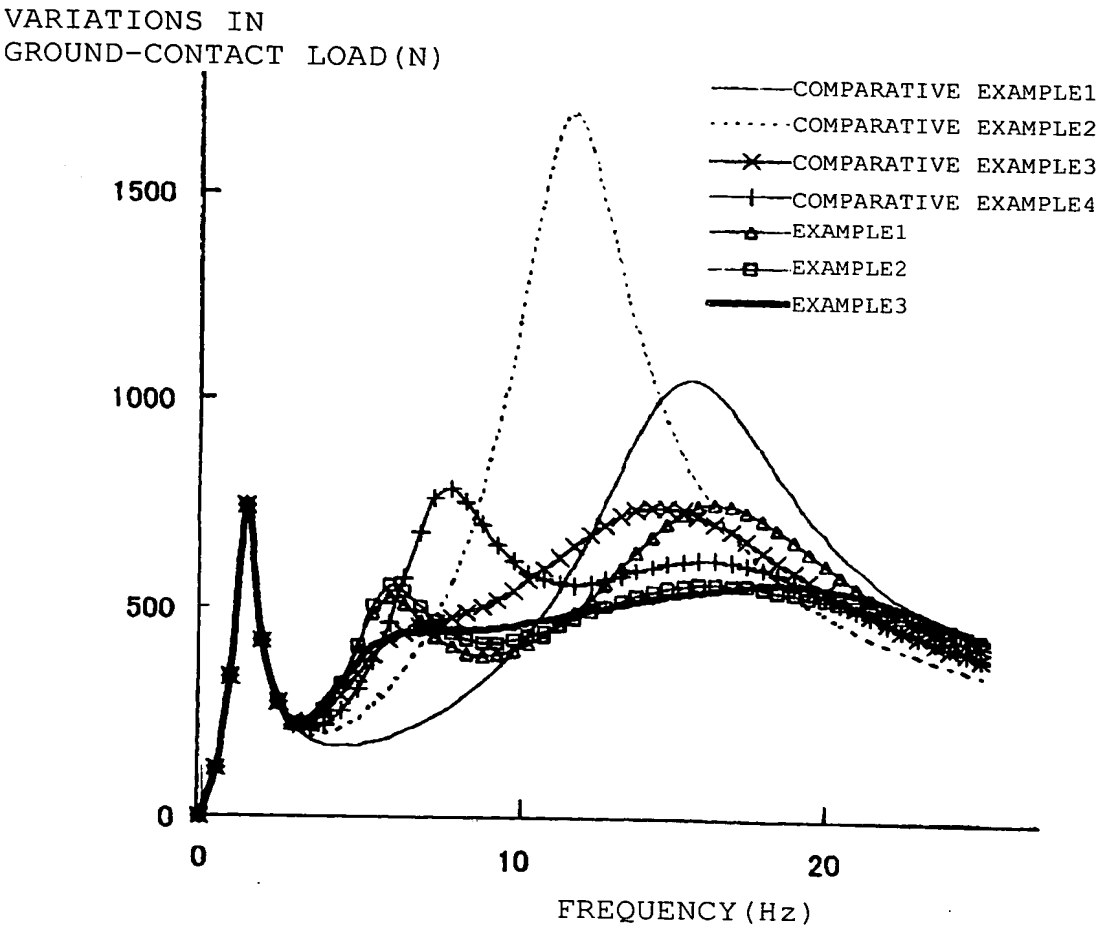

VARIATIONS IN
GROUND-CONTACT LOAD(N)
COMPARATIVE EXAMPLE1
COMPARATIVE EXAMPLE2
COMPARATIVE EXAMPLE3
COMPARATIVE EXAMPLE4
EXAMPLE1
EXAMPLE2
EXAMPLE3
1500
1000
500
0
0
10
20
FREQUENCY(Hz)

FIG.13

	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2	COMPARATIVE EXAMPLE 3	COMPARATIVE EXAMPLE 4	EXAMPLE 1	EXAMPLE 2	EXAMPLE 3
TYPE	CAR MOUNTED	IWM	DD-IWM	DD-IWM	DD-IWM	DD-IWM	DD-IWM
k4 EQUIVALENT SPRING	—	—	—	—	+ SPRING ELEMENT	+ SPRING ELEMENT	+ SPRING ELEMENT
m4 EQUIVALENT MASS	—	—	—	—	—	CYLINDER ADDED TO m4	CYLINDER ADDED TO m4
DYNAMIC DAMPER PORTION				k3 STRONG SPRING	C3 CHANGED	C3 CHANGED	C3, k3 CHANGED
MOTOR(kg)	30	30	30	30	30	30	30
FRAME DRESS-UP PART(kg)	40	40	45	45	45	40	40
DAMPER MASS(kg)	—	—	30	30	30	30	30
m1 (kg)	40	70	45	45	45	40	40
m2 (kg)	370	340	340	340	340	340	340
m3 (kg)	—	—	30	30	30	30	30
m4 (kg)	—	—	—	—	—	5	5
k1 (N/m)	673000	673000	673000	673000	673000	673000	673000
k2 (N/m)	100000	100000	100000	100000	100000	100000	100000
k3 (N/m)	—	—	60000	120000	60000	60000	40000
k4 (N/m)	—	—	—	—	150000	150000	150000
c1 (N/(m/s))	50	50	50	50	50	50	50
c2 (N/(m/s))	1200	1200	1200	1200	1200	1200	1200
c3 (N/(m/s))	—	—	1100	1100	1200	1200	900

FIG.14(a) PRIOR ART

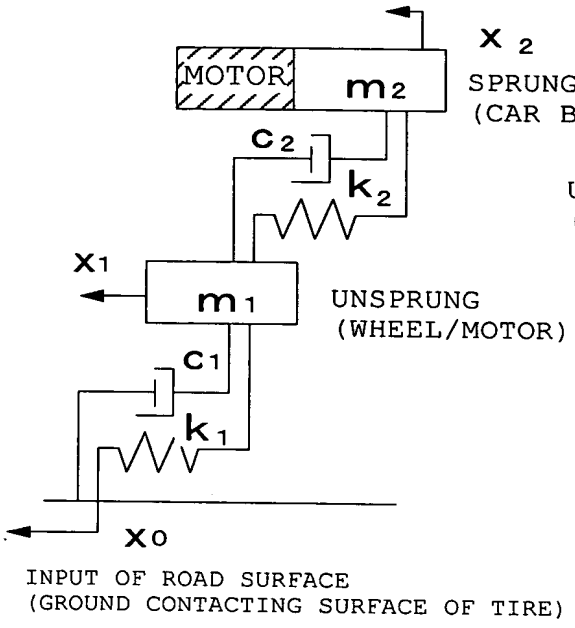


FIG.14(b) PRIOR ART

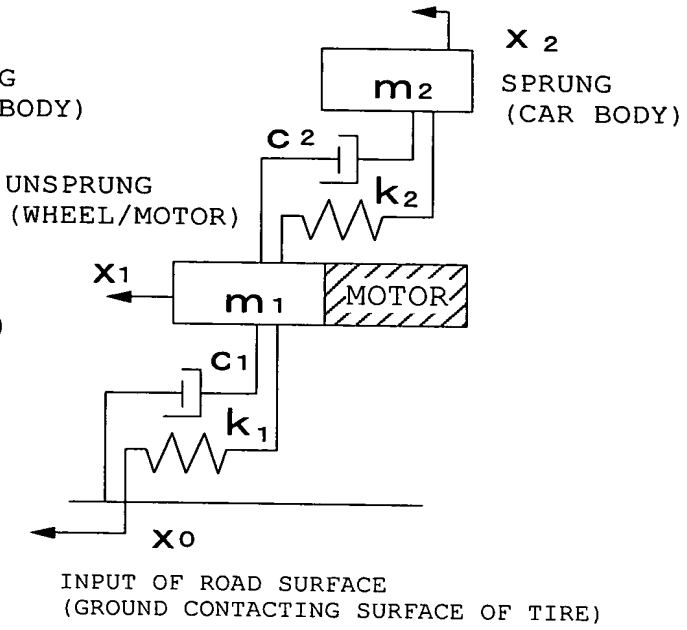


FIG.15 PRIOR ART

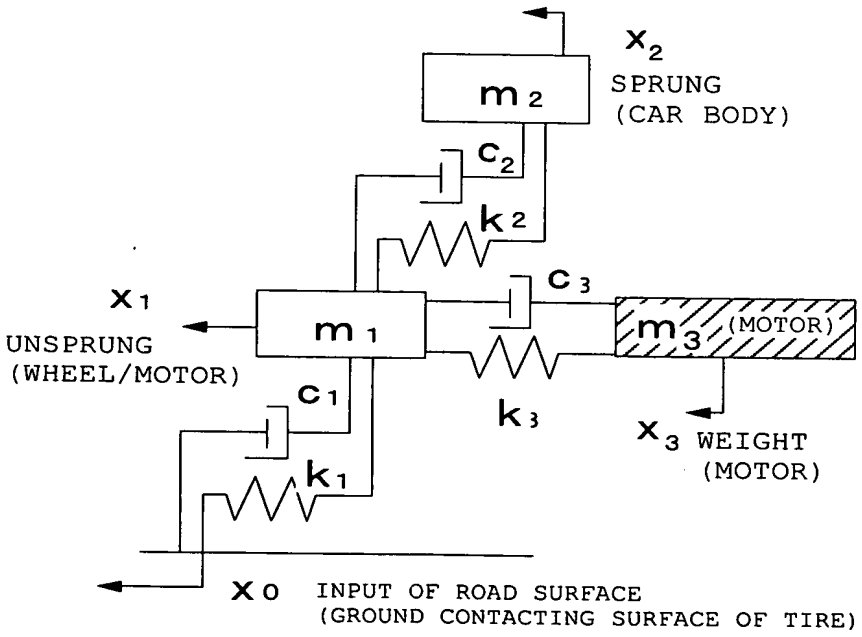


FIG.16

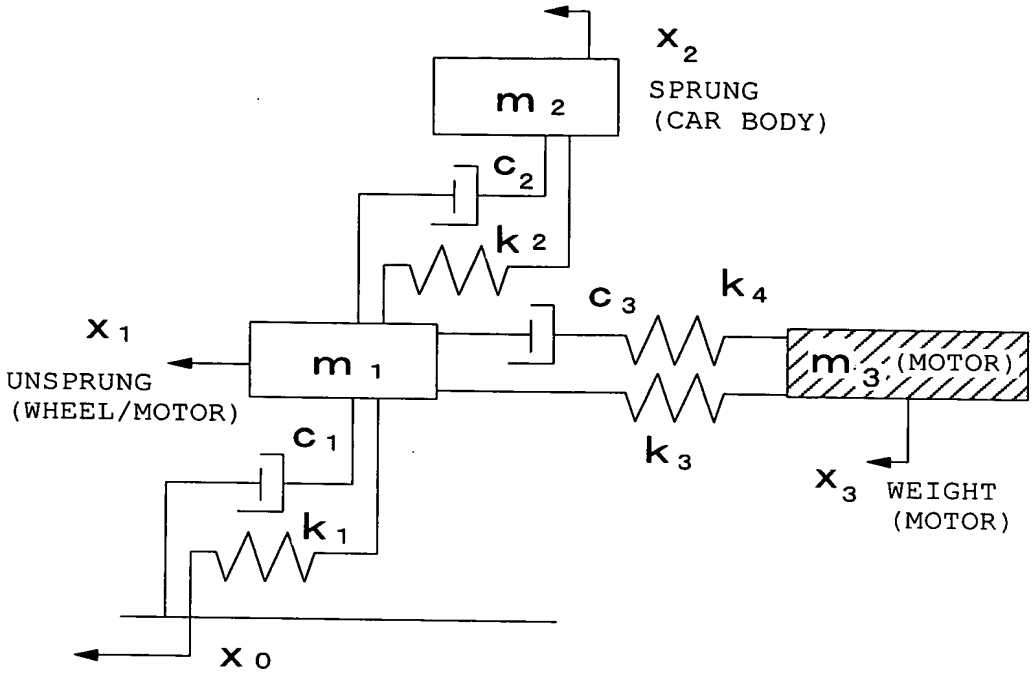

x2
m2
SPRUNG
(CAR BODY)
c2
k2
c3
k4
x1
m1
m3 (MOTOR)
UNSPRUNG
(WHEEL/MOTOR)
k3
c1
x3 WEIGHT
(MOTOR)
k1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.17

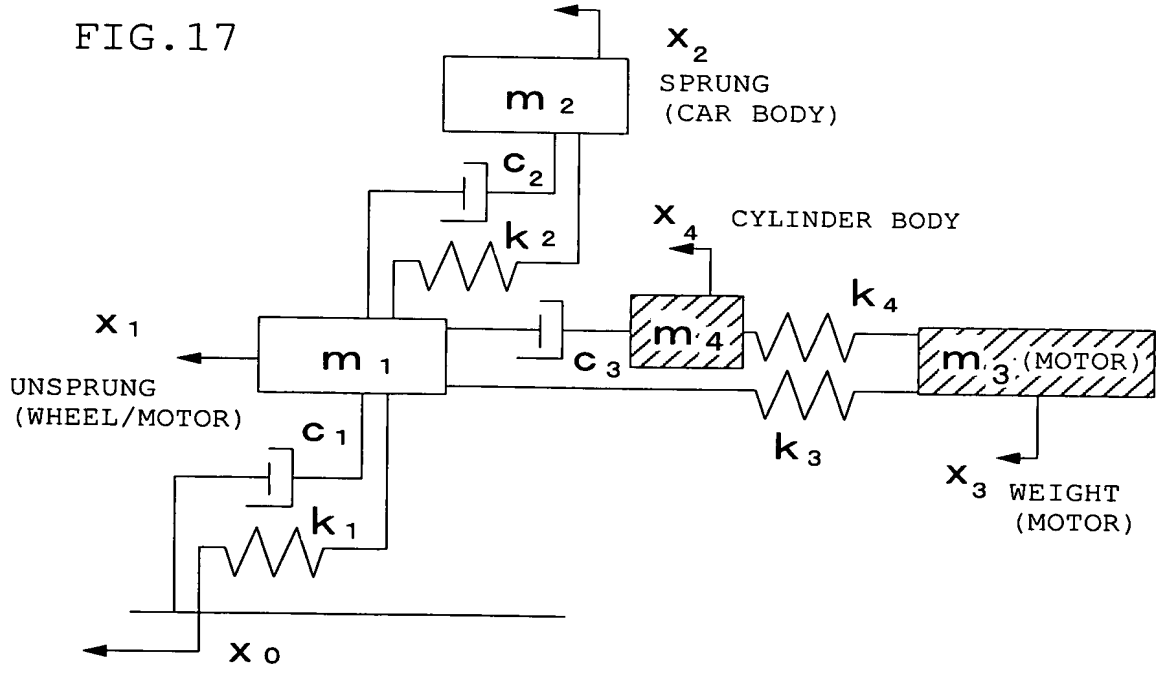

x2
m2
SPRUNG
(CAR BODY)
c2
x4 CYLINDER BODY
k2
k4
x1
m4
m3 (MOTOR)
m1
c3
UNSPRUNG
(WHEEL/MOTOR)
k3
c1
x3 WEIGHT
(MOTOR)
k1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.18

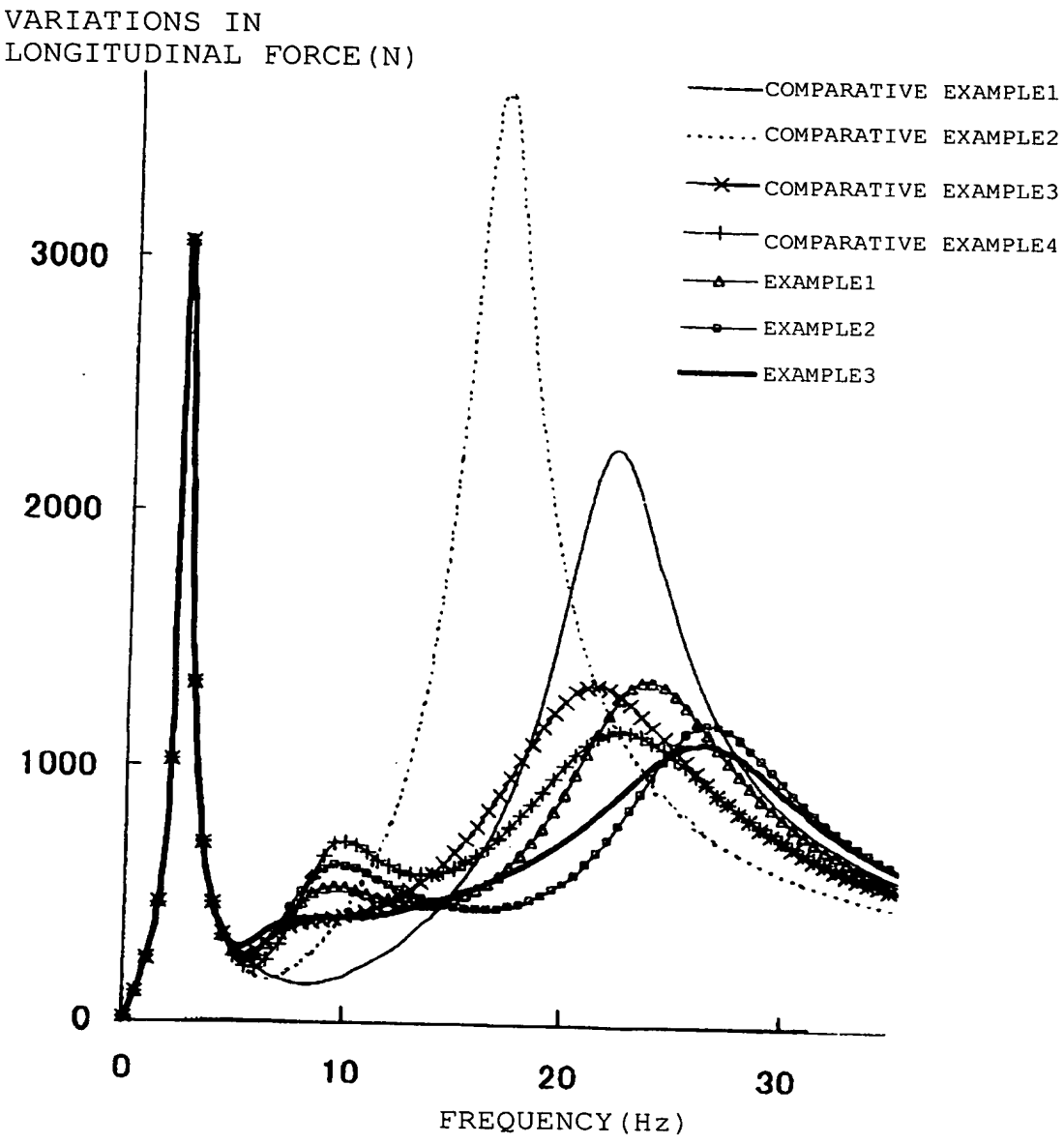

VARIATIONS IN
LONGITUDINAL FORCE(N)
COMPARATIVE EXAMPLE1
COMPARATIVE EXAMPLE2
COMPARATIVE EXAMPLE3
COMPARATIVE EXAMPLE4
EXAMPLE1
EXAMPLE2
EXAMPLE3
3000
2000
1000
0
0
10
20
30
FREQUENCY(Hz)

FIG.19

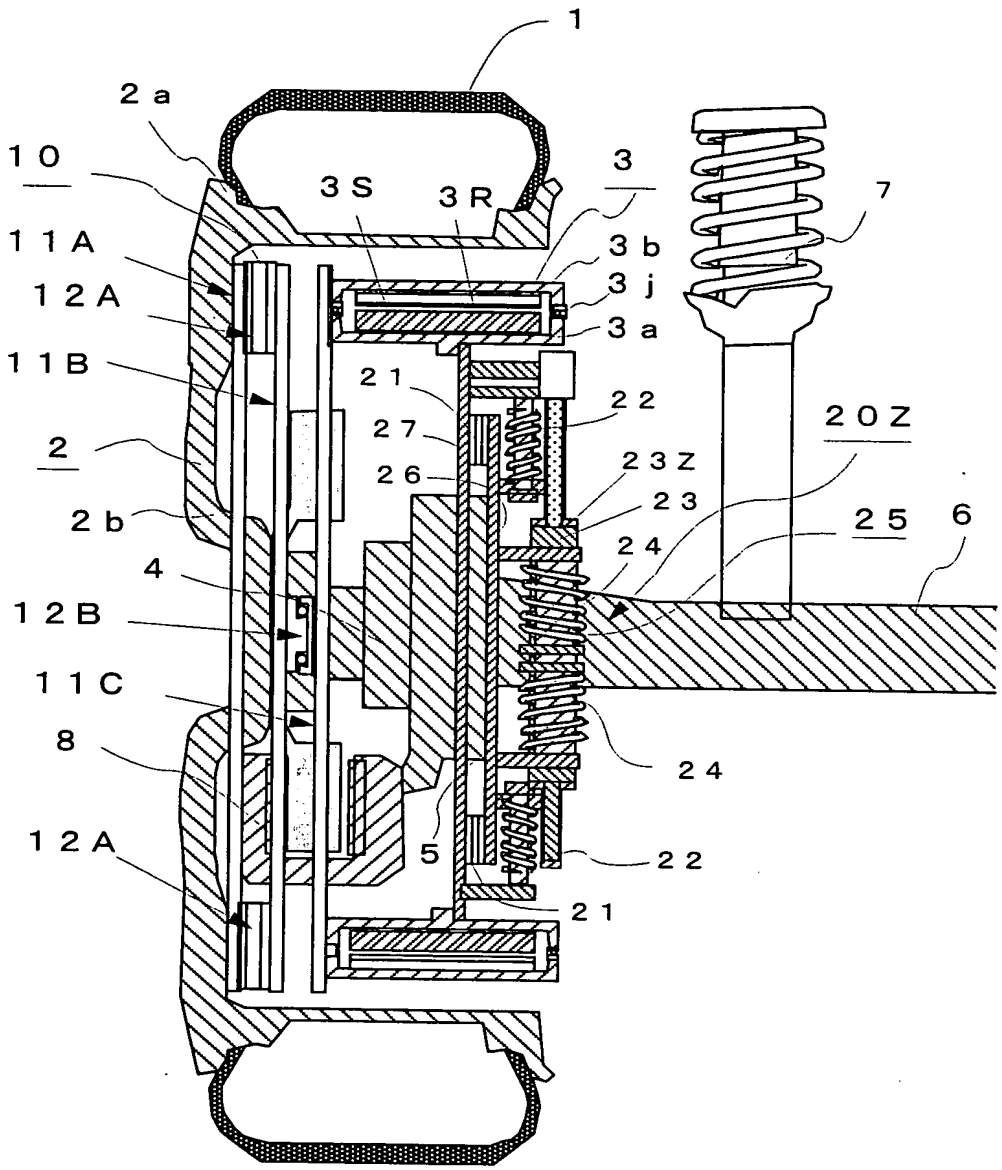
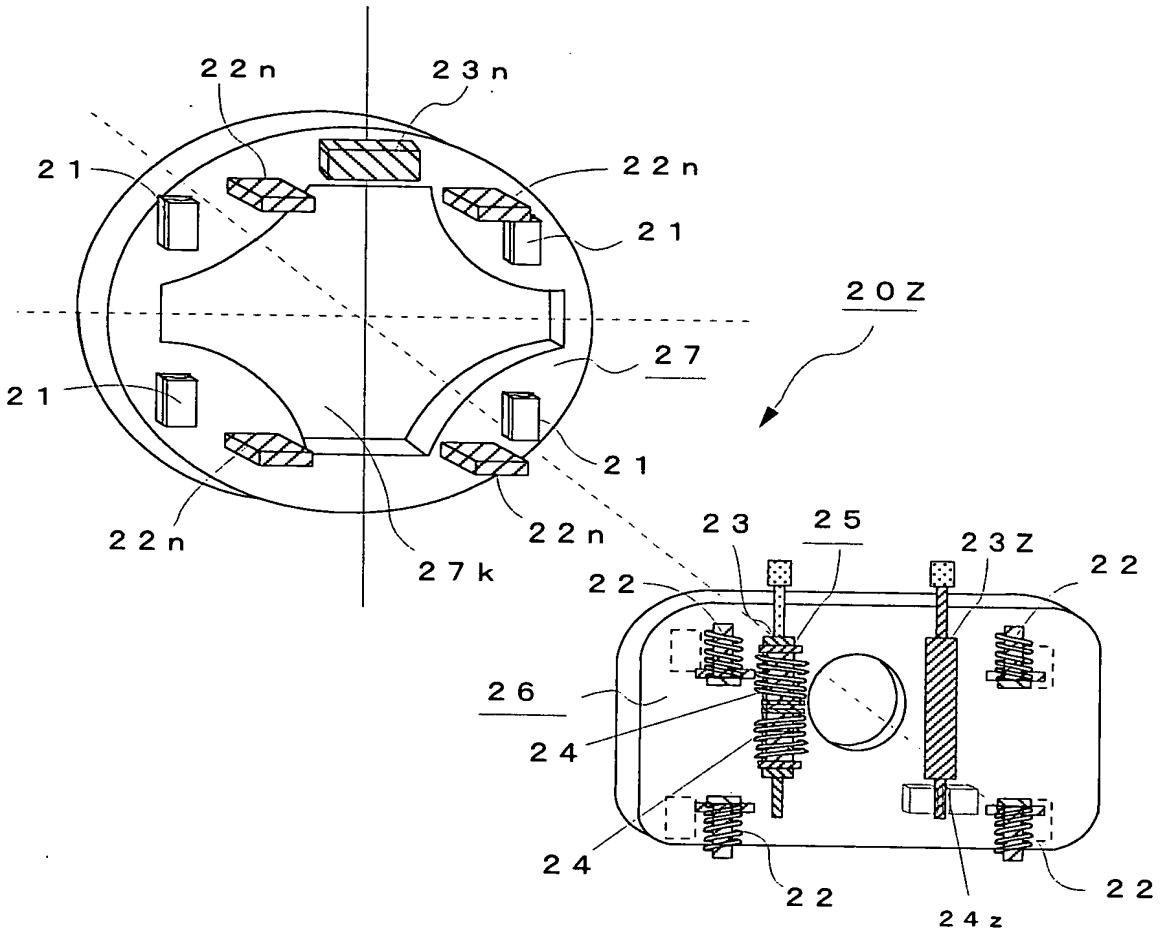

1
2a
10
3S
3R
3
7
11A
3b
12A
3j
3a
11B
21
22
27
20Z
2
26
23Z
23
2b
25
6
24
4
12B
11C
24
8
12A
5
22
21

FIG.20


22n
23n
21
22n
21
20Z
27
21
21
22n
22n
27k
23
25
23Z
22
22
26
24
24
22
22
24z

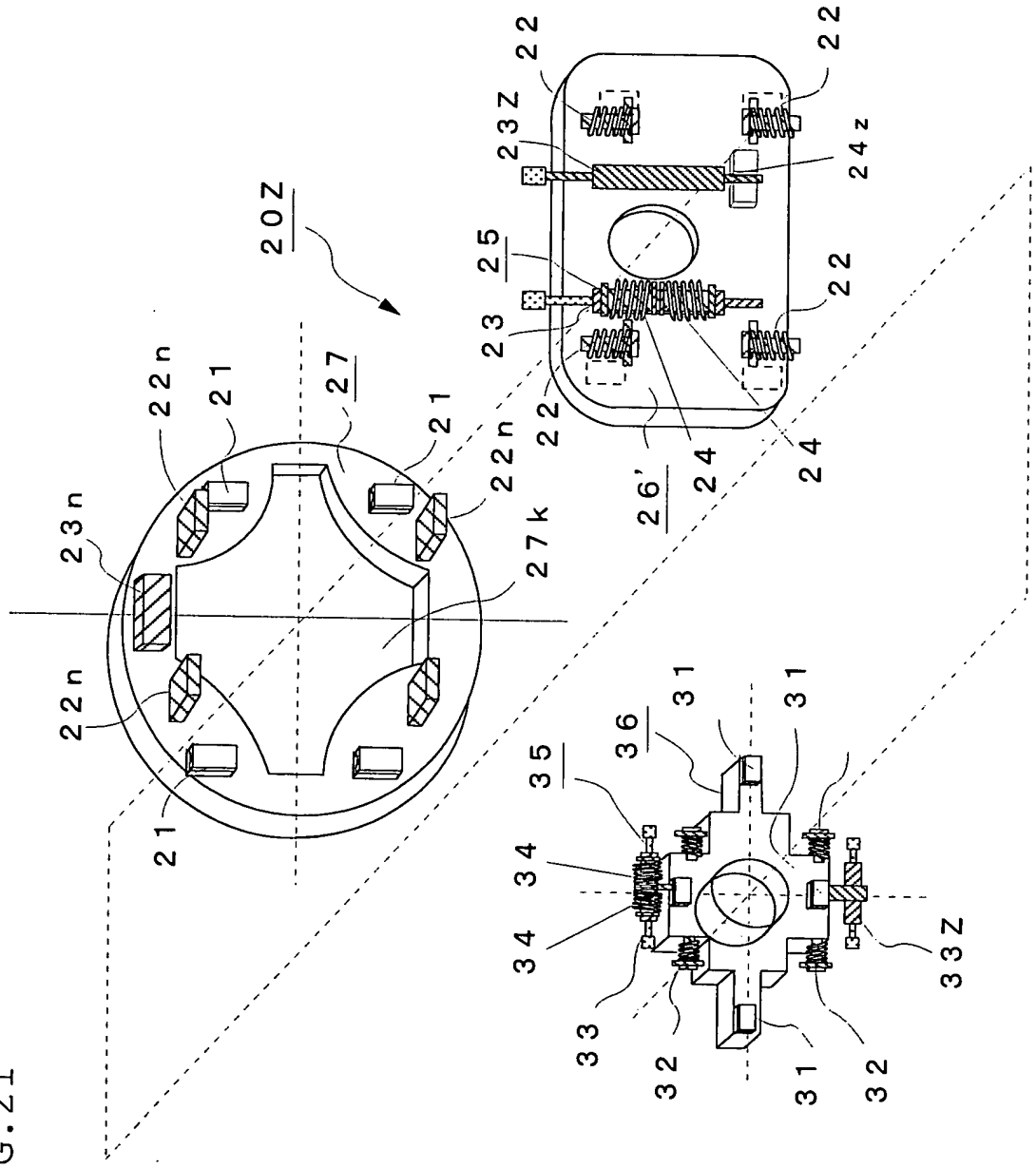


FIG.21

FIG.22

	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2	COMPARATIVE EXAMPLE 3	EXAMPLE 1	EXAMPLE 2
m3 MASS(MOTOR MASS)	—	—	MOTOR	MOTOR+CYLINDER	MOTOR
c3 EQUIVALENT DAMPING	—	—	—	STRONG	WEAK
c4 EQUIVALENT DAMPING	—	—	—	WEAK	STRONG
k4 EQUIVALENT SPRING	—	—	—	STRONG	WEAK
m4 EQUIVALENT MASS	—	—	—	—	CYLINDER
UNSPRUNG MASS m1 (kg)	40	70	45	40	40
SPRUNG MASS m1 (kg)	370	340	340	340	340
MASS m3 (kg) OF DYNAMIC DAMPER (MOTOR)	—	—	30	35	30
CYLINDER MASS m4 (kg)	—	—	—	—	5
TIRE LONGITUDINAL SPRING k1 (N/m)	360000	360000	360000	360000	360000
CAR SUSPENSION SPRING k2 (N/m)	32000	32000	32000	32000	32000
MOTOR SUPPORTING SPRING k3 (N/m)	—	—	41000	41000	30000
DAMPER SUPPORTING SPRING k4 (N/m)	—	—	—	170000	120000
TIRE DAMPING c1 (N/(m/s))	50	50	50	50	50
SUSPENSION DAMPING c2 (N/(m/s))	1500	1500	1500	1500	1500
DAMPER ①c3 (N/(m/s)) FOR DYNAMIC DAMPER	—	—	1000	1000	200
DAMPER ②c4 (N/(m/s)) FOR DYNAMIC DAMPER	—	—	—	500	900

FIG.23(a) PRIOR ART

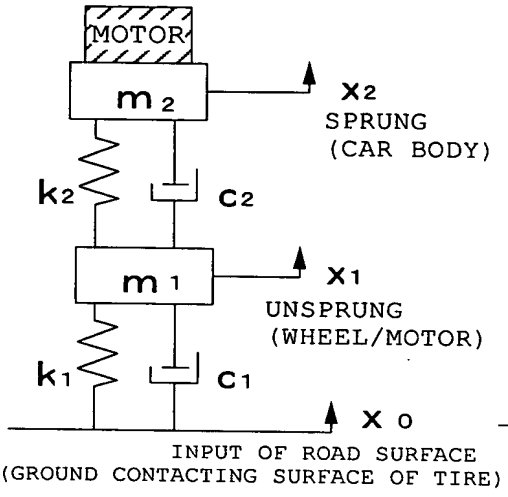


FIG.23(b) PRIOR ART

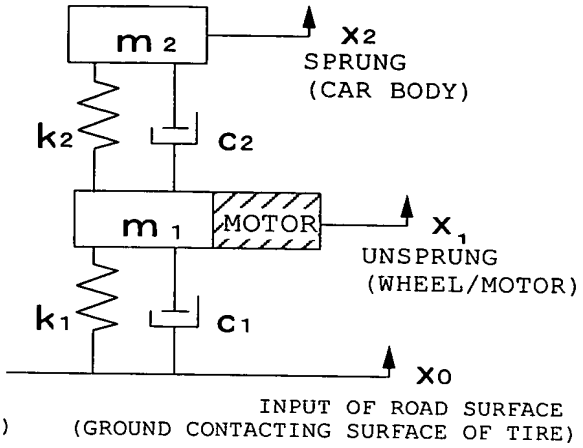


FIG.24 PRIOR ART

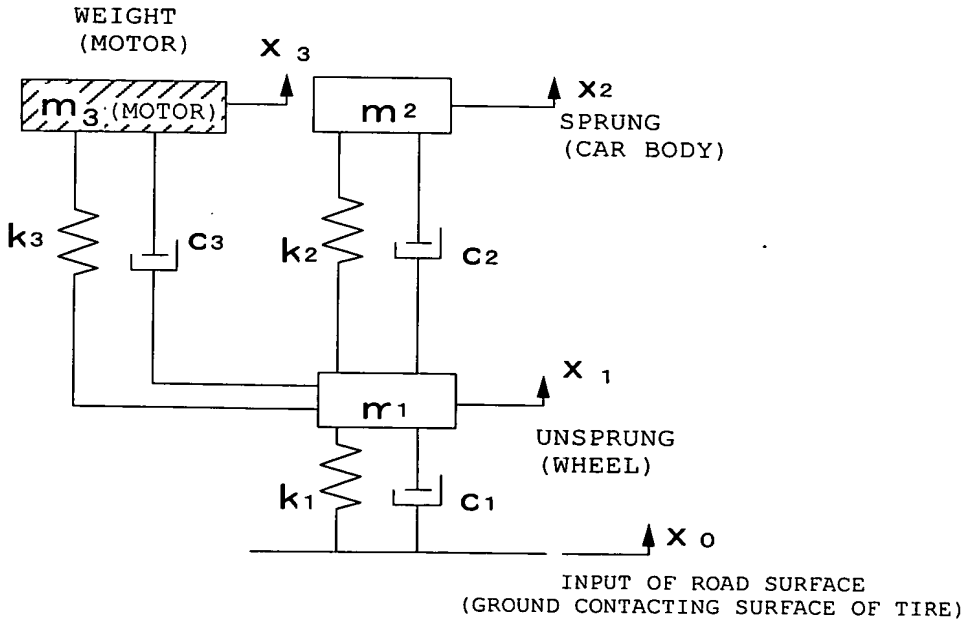


FIG.25

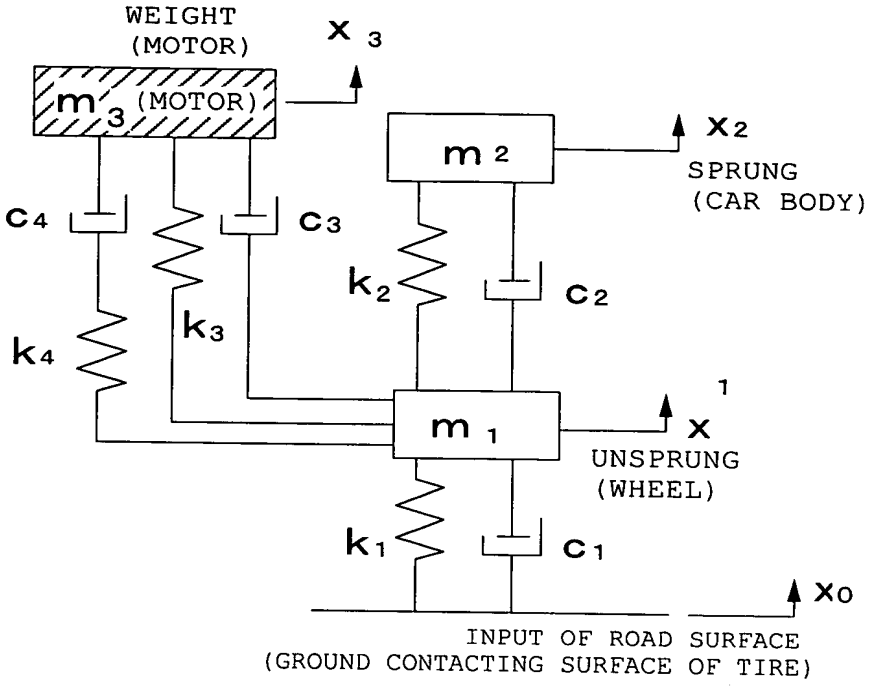

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
m 2
x2
SPRUNG
(CAR BODY)
c4
c3
k2
c2
k3
k4
m 1
x 1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.26

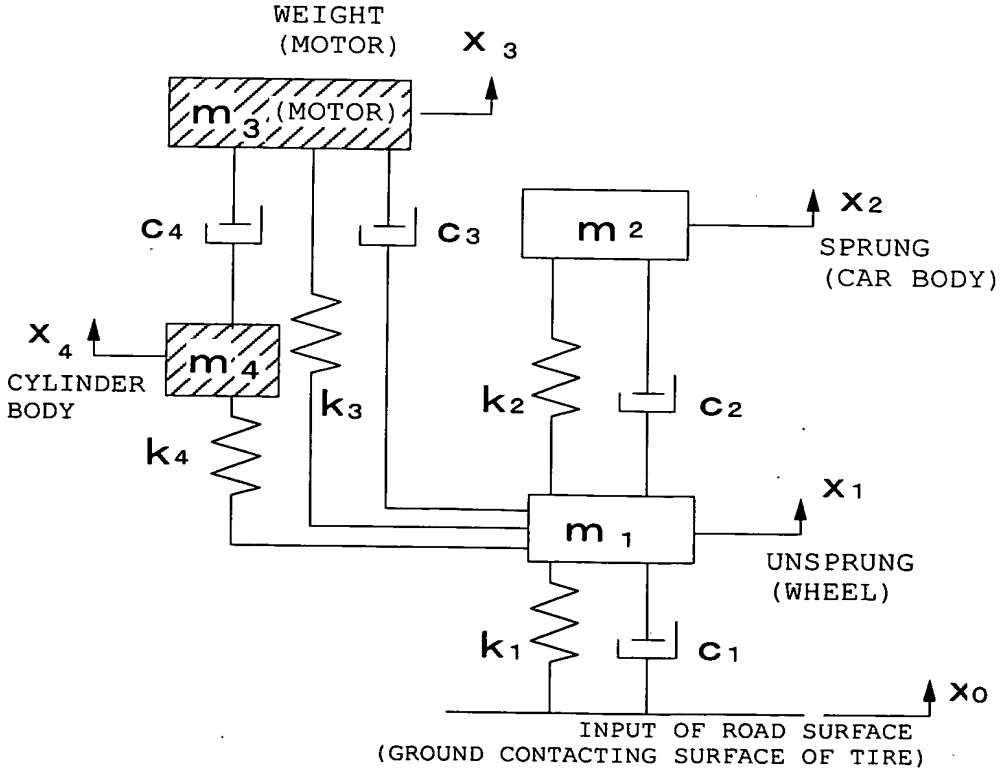

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
c4
c3
m 2
x2
SPRUNG
(CAR BODY)
x 4
m 4
CYLINDER
BODY
k3
k2
c2
k4
x 1
m 1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.27

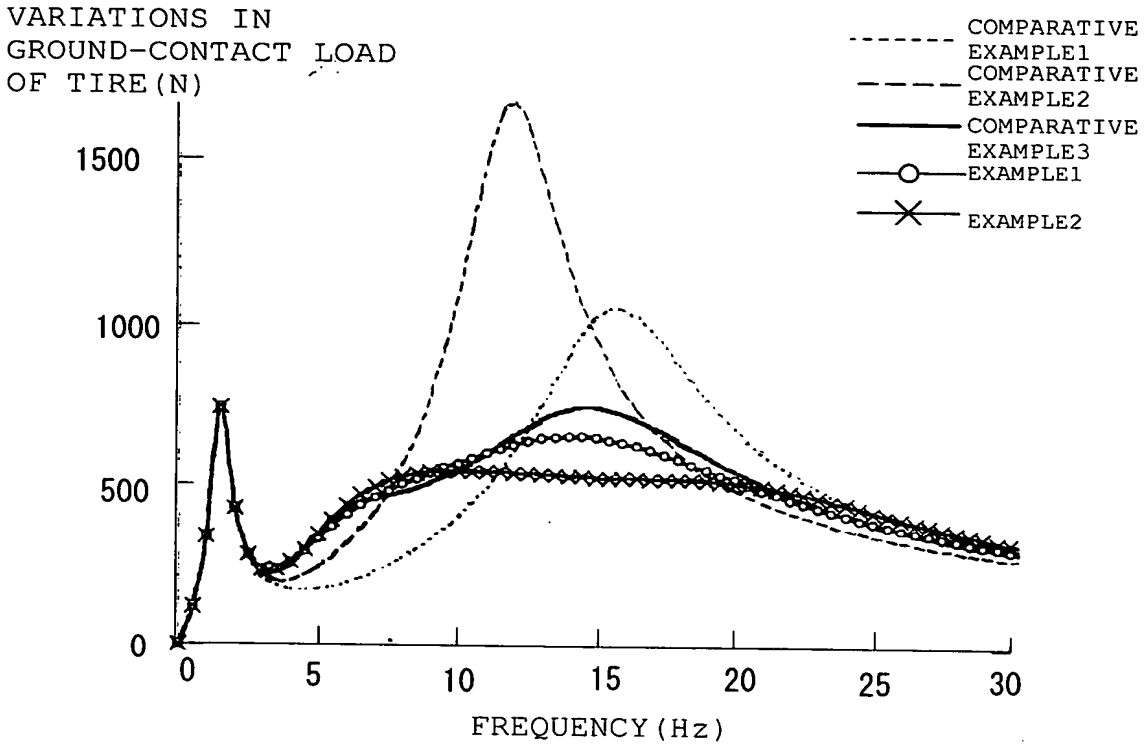

VARIATIONS IN GROUND-CONTACT LOAD OF TIRE(N)
1500
1000
500
0
0
5
10
15
20
25
30
FREQUENCY(Hz)
COMPARATIVE EXAMPLE1
COMPARATIVE EXAMPLE2
COMPARATIVE EXAMPLE3
EXAMPLE1
EXAMPLE2

FIG.28(a) PRIOR ART

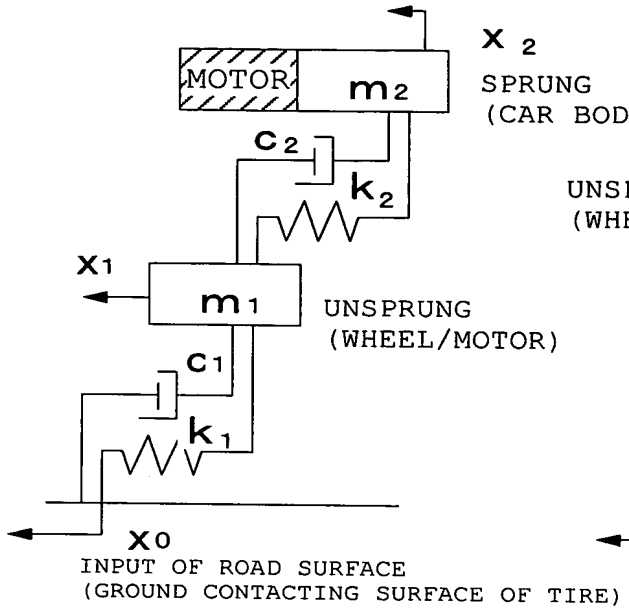


FIG.28(b) PRIOR ART

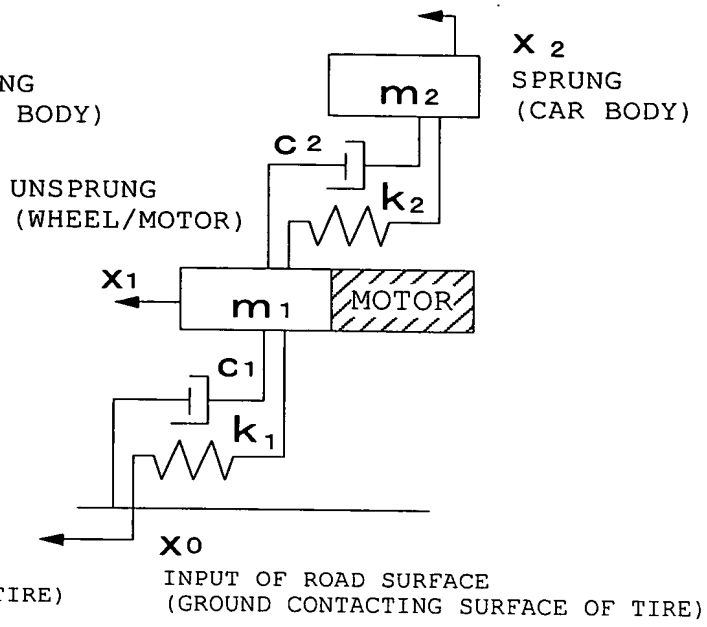


FIG.29

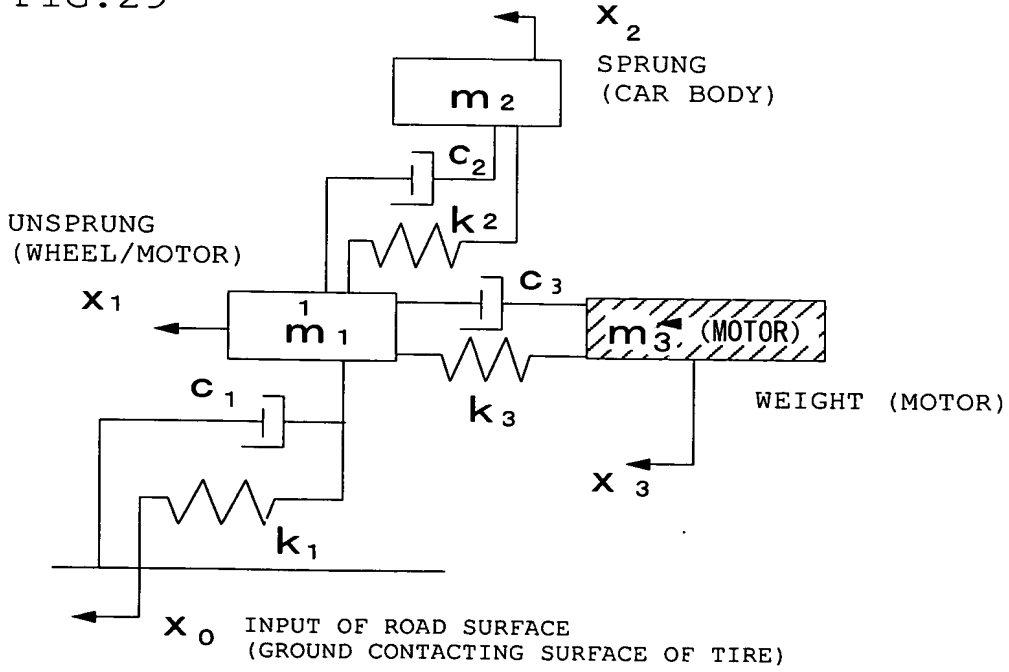


FIG.30

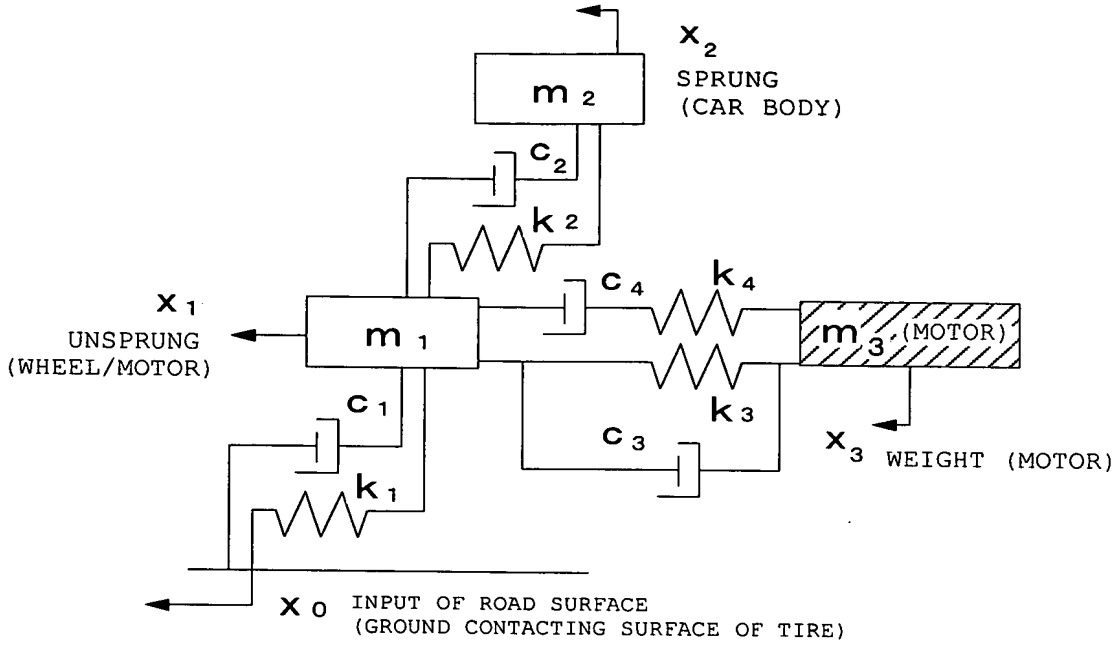

x2
m2
SPRUNG
(CAR BODY)
c2
k2
x1
UNSPRUNG
(WHEEL/MOTOR)
m1
c4
k4
m3 (MOTOR)
k3
c1
c3
x3 WEIGHT (MOTOR)
k1
x0 INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.31

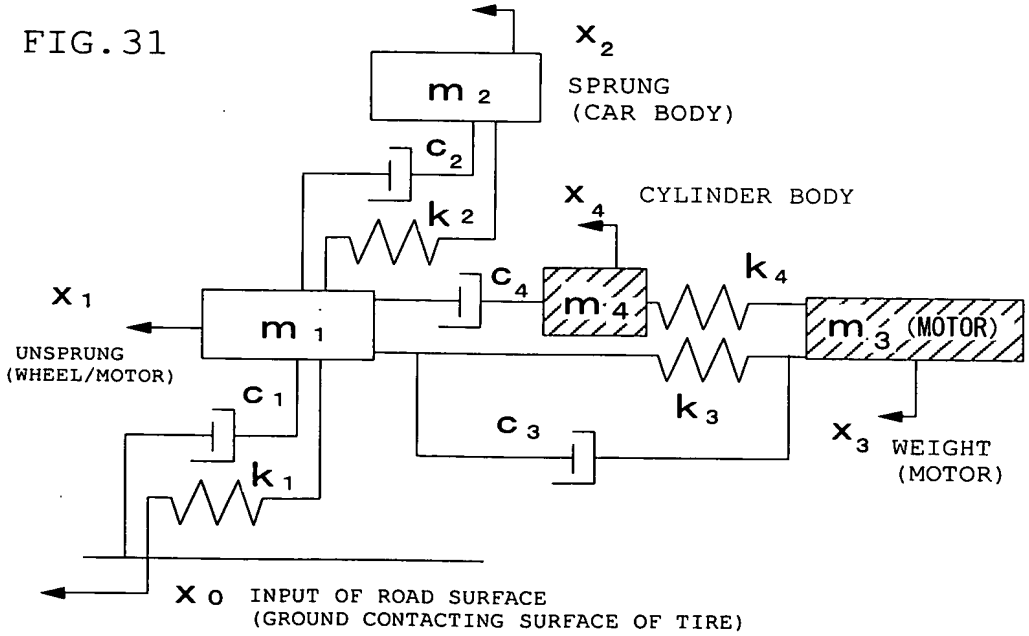

x2
m2
SPRUNG
(CAR BODY)
c2
x4 CYLINDER BODY
k2
x1
c4
m4
k4
m3 (MOTOR)
UNSPRUNG
(WHEEL/MOTOR)
m1
c1
k3
c3
x3 WEIGHT
(MOTOR)
k1
x0 INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.32

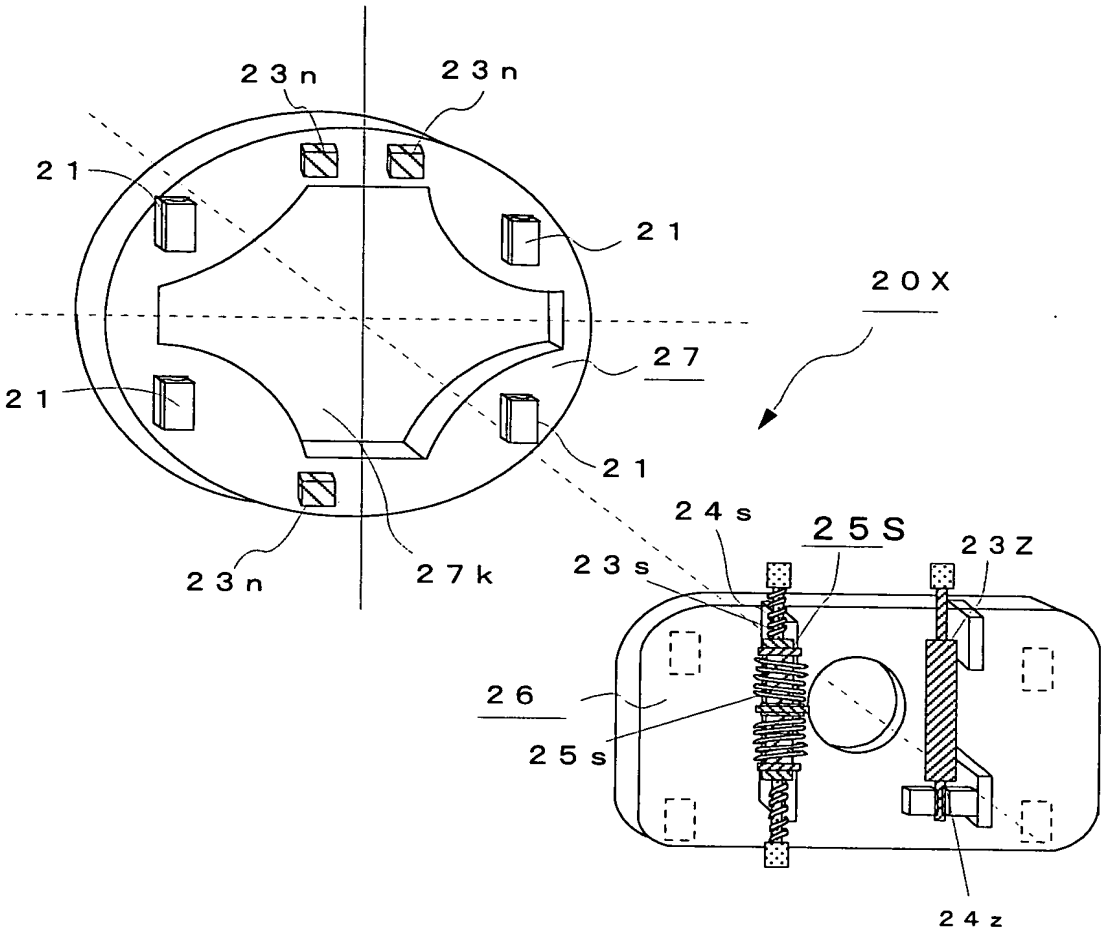


FIG.33

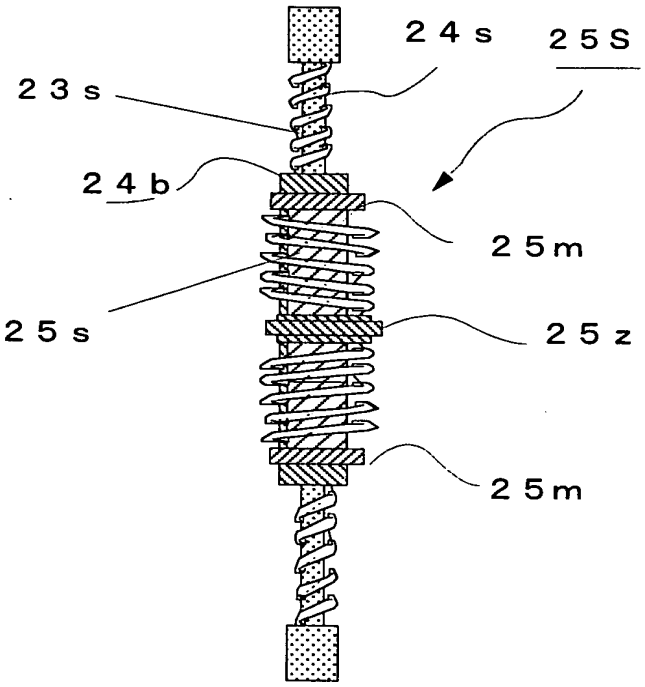
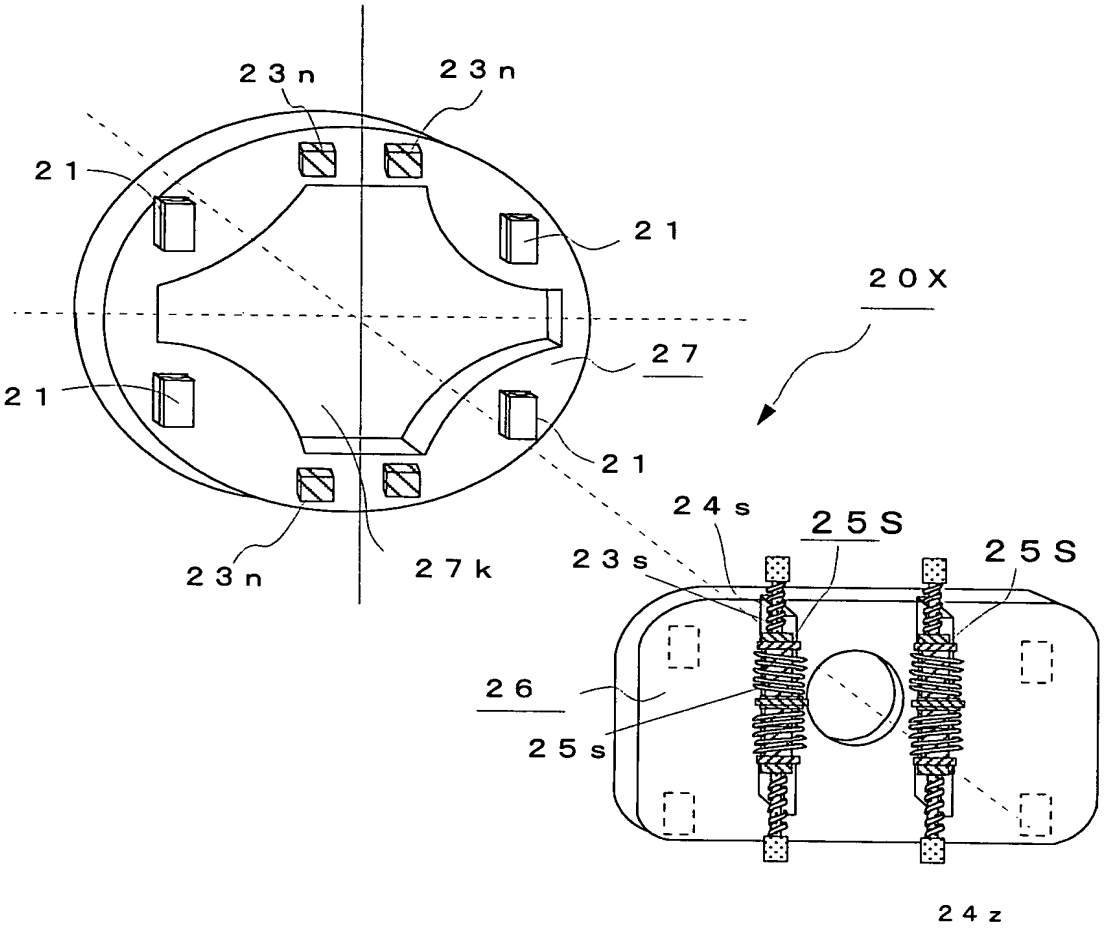


FIG.34



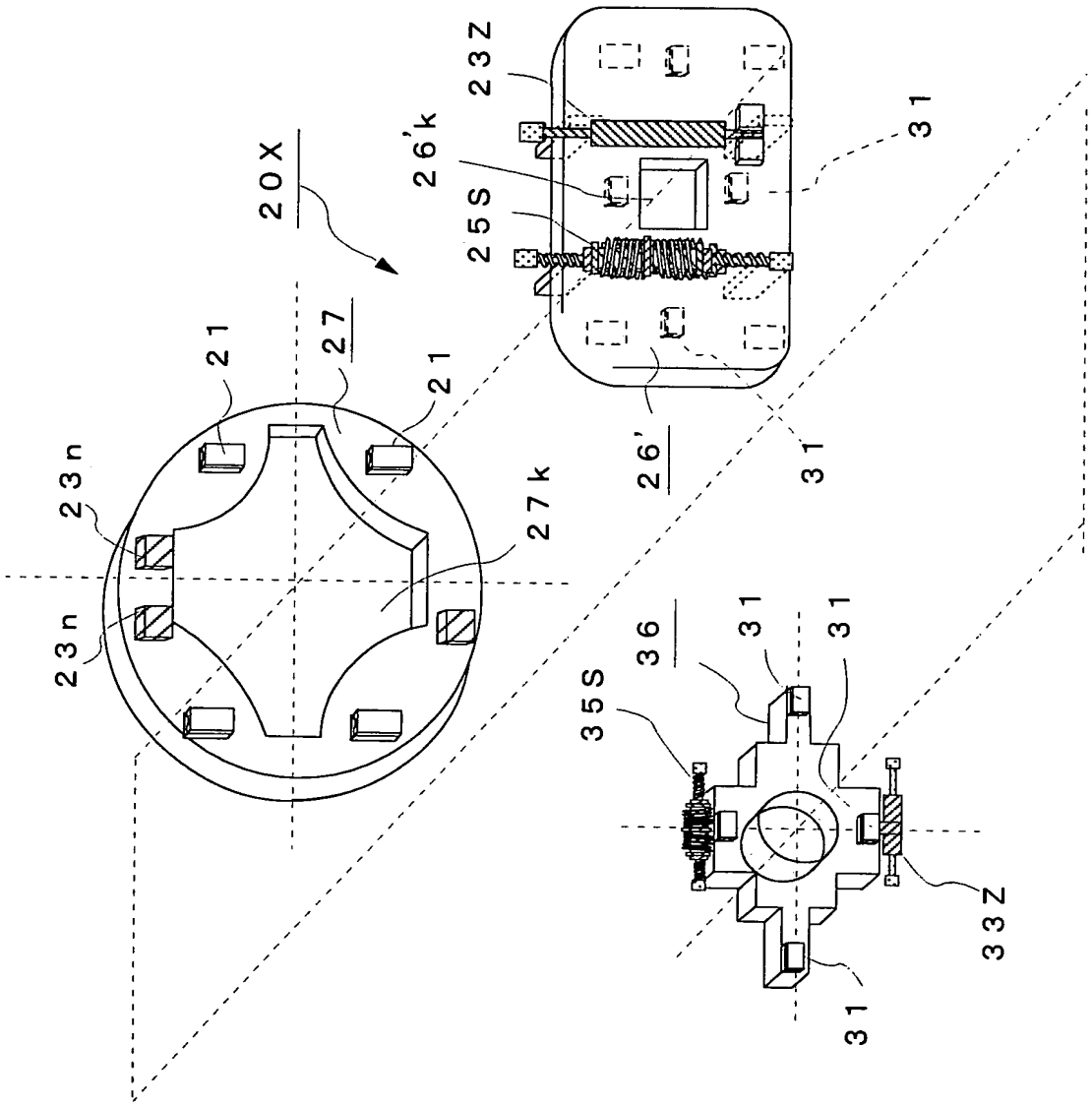
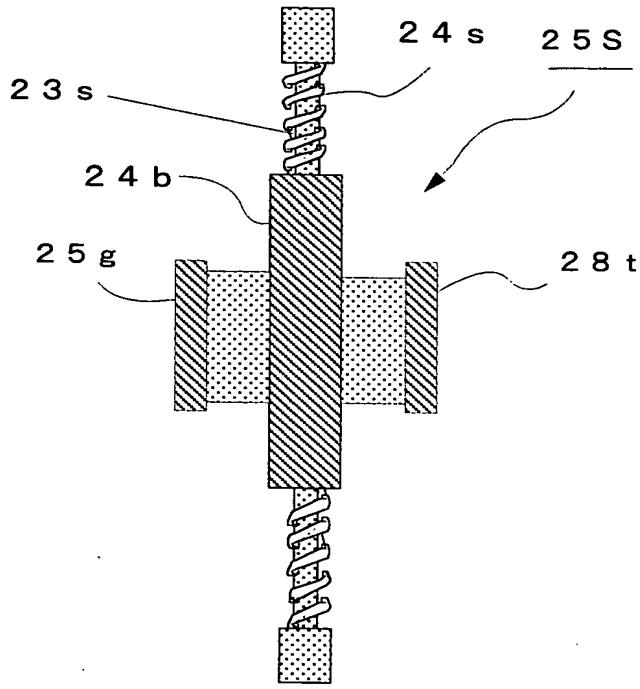


FIG. 35

FIG.36



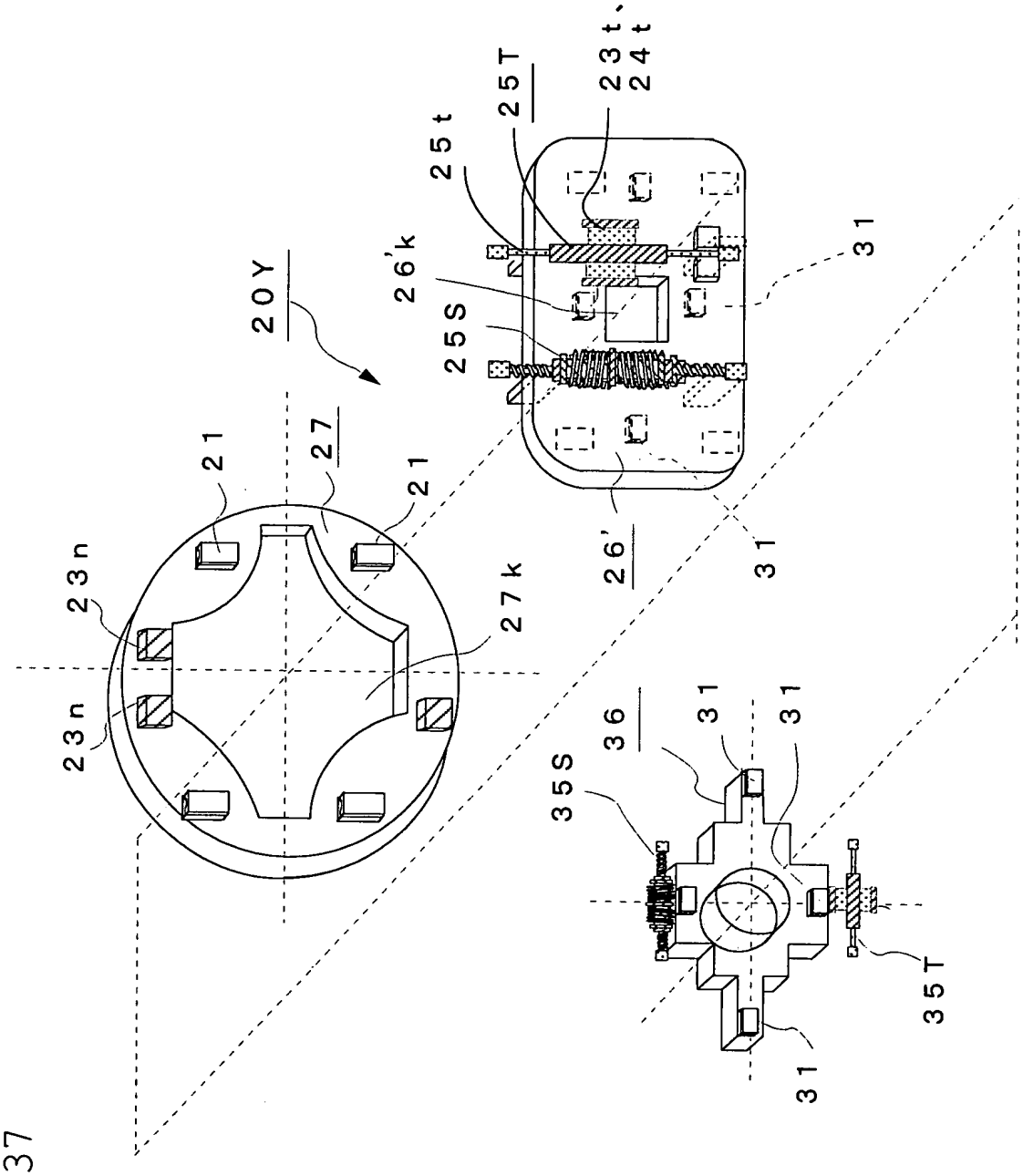

20Y
21
27
21
23n
23n
27k
26'k
25S
25t
25T
23t,
24t
31
26'
31
36
31
31
35S
35T
31

FIG.37

FIG.38

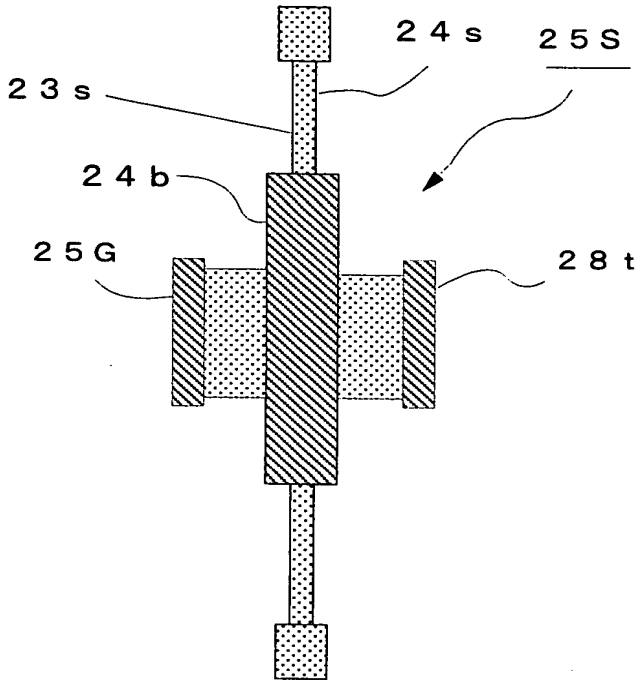


FIG.39

	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2	COMPARATIVE EXAMPLE 3	EXAMPLE 1	EXAMPLE 2	EXAMPLE 3	EXAMPLE 4
TYPE	CAR MOUNTED	I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM
MOTOR SUPPORTING METHOD	—	—	k3, c3	k3, D1	k3, D1 CYLINDER ADDED TO m5	k3, D2	k3, D2 CYLINDER ADDED TO m4, m5
m1 (kg)	40	70	40	40	40	40	40
m2 (kg)	350	300	300	300	300	300	300
m3 (kg)	—	—	32	32	30	32	30
m4 (kg)	—	—	—	—	—	—	1
m5 (kg)	—	—	—	—	2	—	1
k1 (N/m)	360000	360000	360000	360000	360000	360000	360000
k2 (N/m)	32000	32000	32000	32000	32000	32000	32000
k3 (N/m)	—	—	39200	140000	210000	90000	120000
k4 (N/m)	—	—	—	—	—	120000	90000
k5 (N/m)	—	—	—	40000	40000	40000	40000
c1 (N/(m/s))	50	50	50	50	50	50	50
c2 (N/(m/s))	1500	1500	1500	1500	1500	1500	1500
c3 (N/(m/s))	—	—	1000	300	—	700	500
c4 (N/(m/s))	—	—	—	—	—	50	50
c5 (N/(m/s))	—	—	—	1500	1700	1500	1500

D1 ; COMPOSITE CONNECTION DAMPER、D2 ; SECOND COMPOSITE CONNECTION DAMPER

FIG.40(a) PRIOR ART

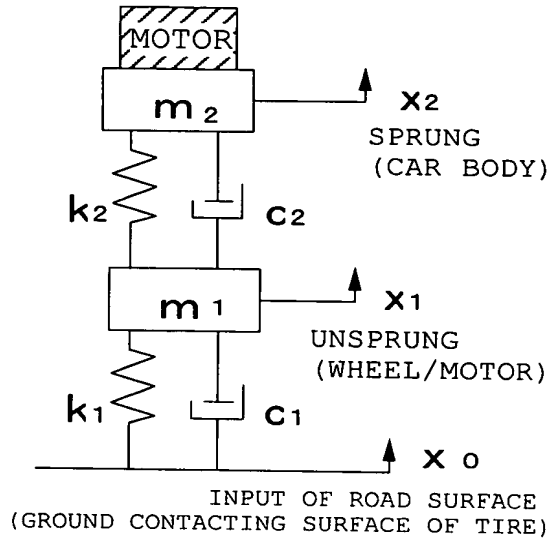


FIG.40(b) PRIOR ART

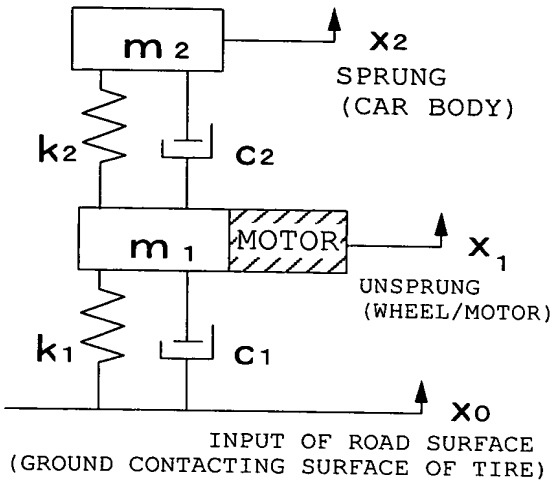


FIG.41 PRIOR ART

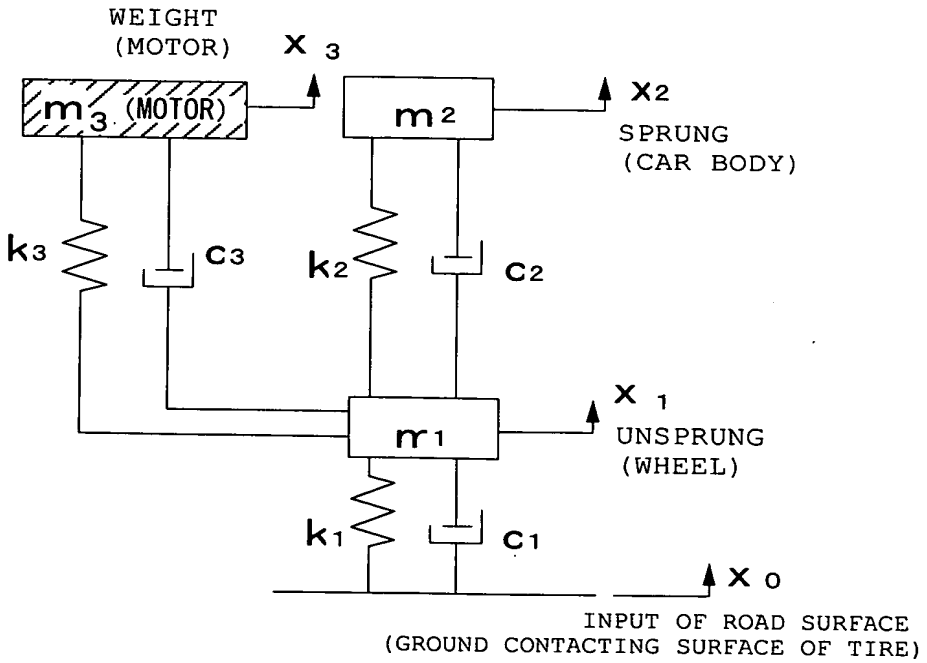


FIG.42

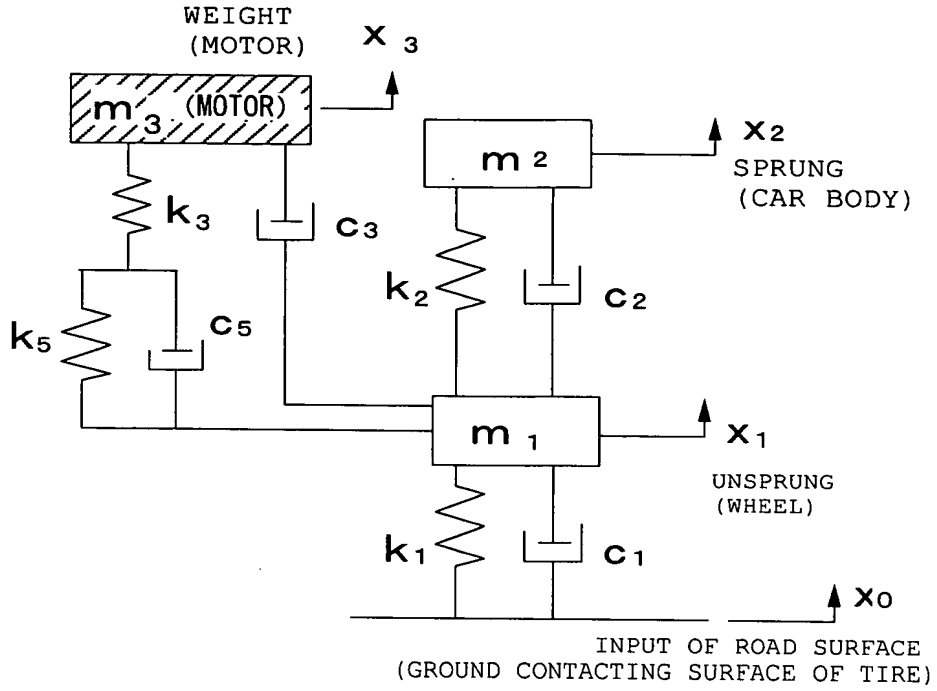

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
m 2
x2
SPRUNG
(CAR BODY)
k3
c3
k2
c2
k5
c5
m 1
x1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.43

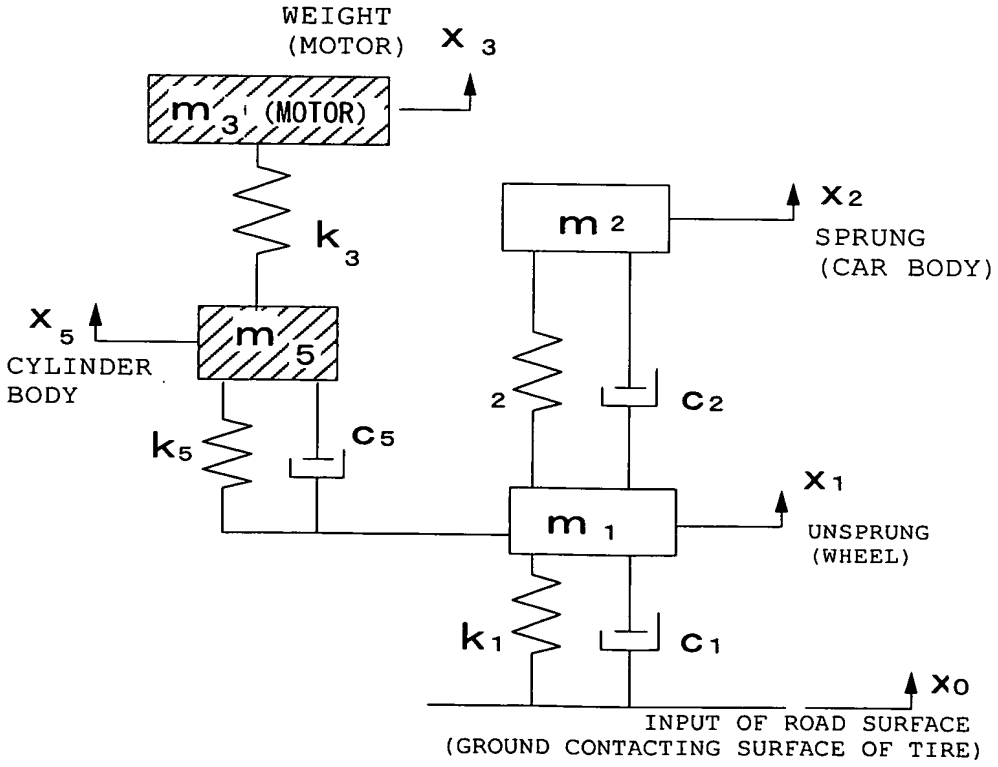

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
k3
m 2
x2
SPRUNG
(CAR BODY)
x 5
CYLINDER
BODY
m 5
2
c2
k5
c5
x1
m 1
UNSPRUNG
(WHEEL)
k1
c1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.44

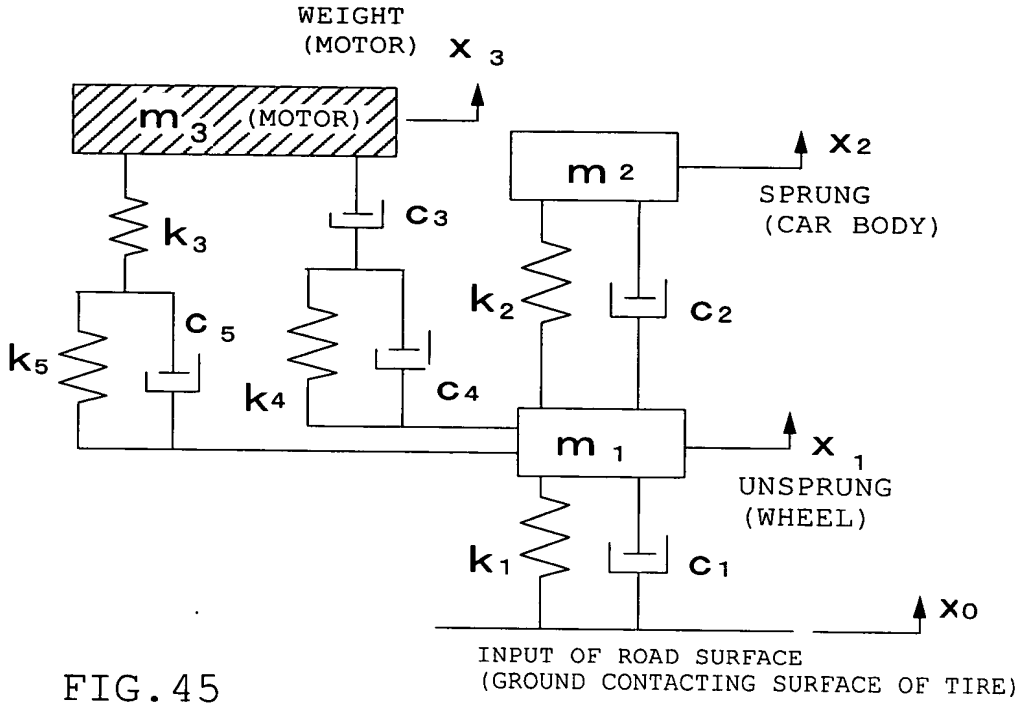

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
m 2
x2
SPRUNG
(CAR BODY)
k3
c3
k2
c2
c 5
k5
k4
c4
m 1
x 1
UNSPRUNG
(WHEEL)
k1
c1
xo
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.45

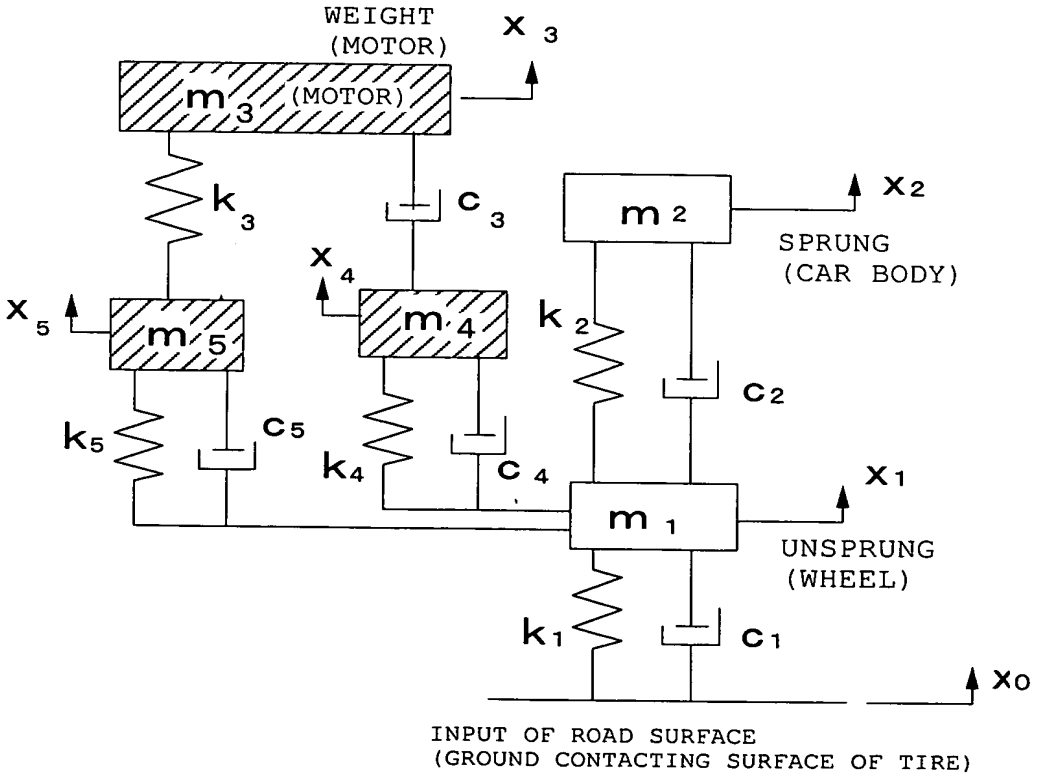

WEIGHT
(MOTOR)
x 3
m 3 (MOTOR)
k3
c3
m 2
x2
SPRUNG
(CAR BODY)
x 4
x 5
m 5
m 4
k 2
c2
k5
c5
k4
c 4
x1
m 1
UNSPRUNG
(WHEEL)
k1
c1
xo
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.46

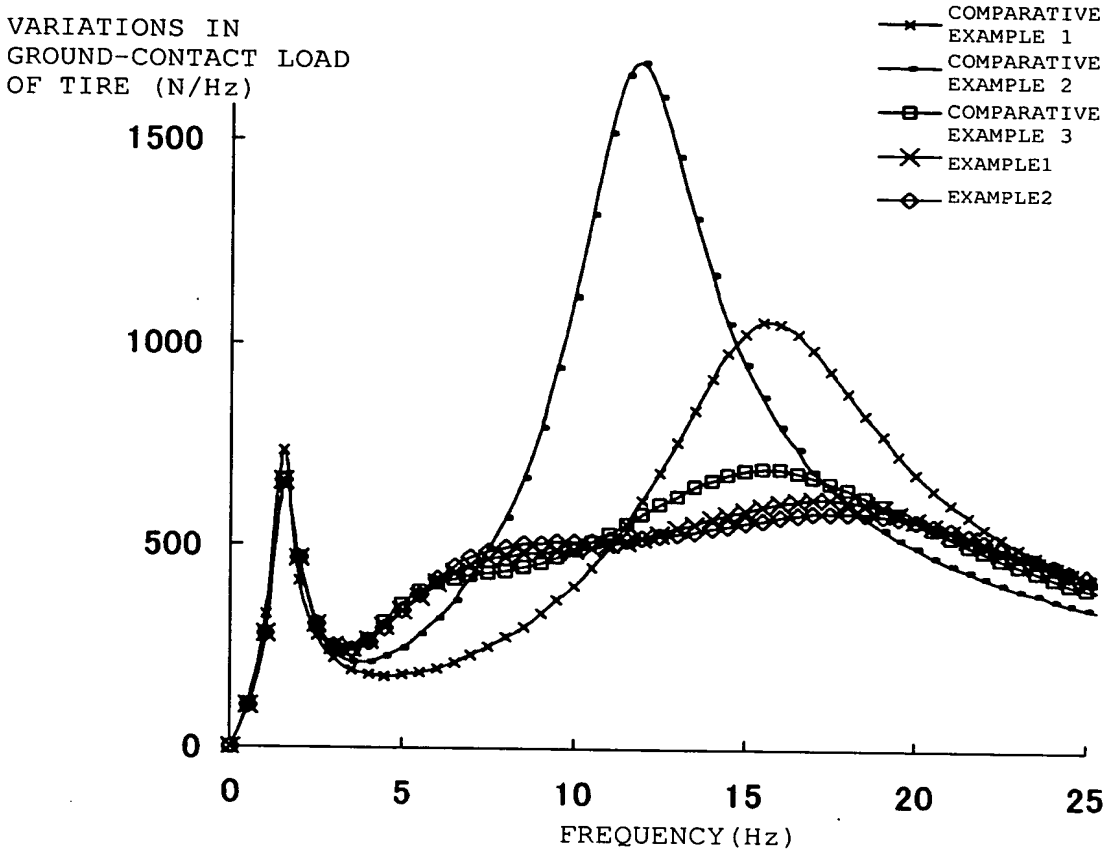

VARIATIONS IN GROUND-CONTACT LOAD OF TIRE (N/Hz)
1500
1000
500
0
0
5
10
15
20
25
FREQUENCY(Hz)
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
COMPARATIVE EXAMPLE 3
EXAMPLE1
EXAMPLE2

FIG.47

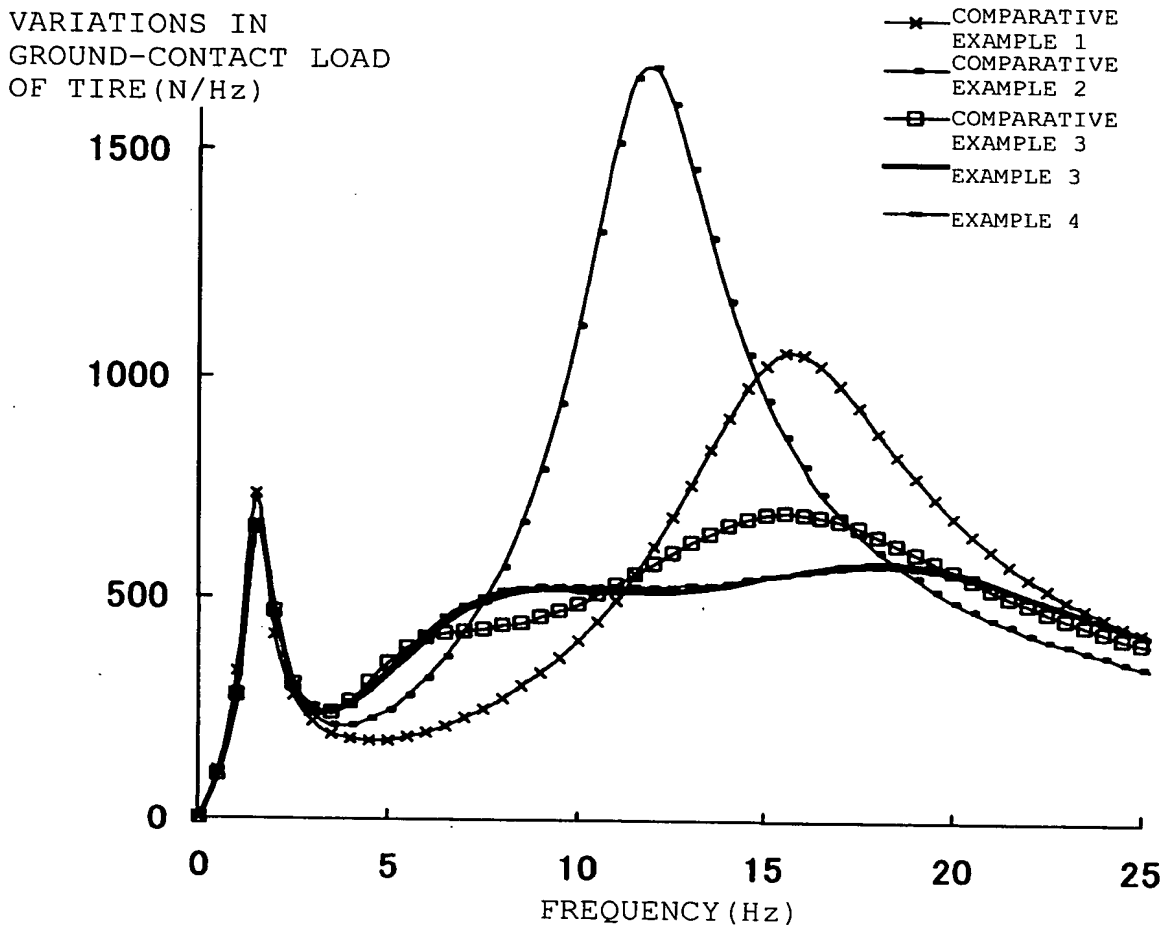

VARIATIONS IN GROUND-CONTACT LOAD OF TIRE(N/Hz)
1500
1000
500
0
0
5
10
15
20
25
FREQUENCY(Hz)
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
COMPARATIVE EXAMPLE 3
EXAMPLE 3
EXAMPLE 4

FIG.48

	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2	COMPARATIVE EXAMPLE 3	EXAMPLE 1	EXAMPLE 2	EXAMPLE 3	EXAMPLE 4
TYPE	CAR MOUNTED	I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM	DD-I WM
MOTOR SUPPORTING METHOD	—	—	k3, c3	k3, D1	k3, D1 CYLINDER ADDED TO m5	k3, D2	k3, D2 CYLINDER ADDED TO m4, m5
m1 (kg)	40	70	40	40	40	40	40
m2 (kg)	350	300	300	300	300	300	300
m3 (kg)	—	—	32	32	30	32	30
m4 (kg)	—	—	—	—	—	—	1
m5 (kg)	—	—	—	—	2	—	1
k1 (N/m)	670000	670000	670000	670000	670000	670000	670000
k2 (N/m)	100000	100000	100000	100000	100000	100000	100000
k3 (N/m)	—	—	60000	140000	450000	400000	400000
k4 (N/m)	—	—	—	—	—	60000	60000
k5 (N/m)	—	—	—	100000	60000	40000	40000
c1 (N/(m/s))	50	50	50	50	50	50	50
c2 (N/(m/s))	1200	1200	1200	1200	1200	1200	1200
c3 (N/(m/s))	—	—	1100	1200	—	1200	1200
c4 (N/(m/s))	—	—	—	—	—	50	50
c5 (N/(m/s))	—	—	—	2000	2200	1700	1700

D1 ; COMPOSITE CONNECTION DAMPER、D2 ; SECOND COMPOSITE CONNECTION DAMPER

FIG.49(a) PRIOR ART

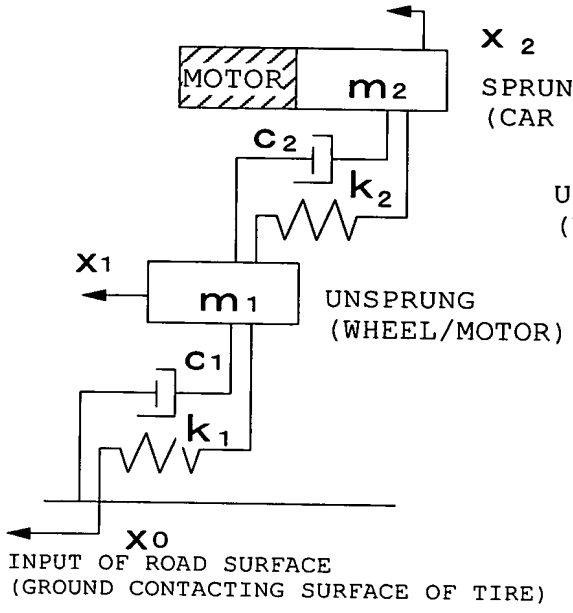


FIG.49(b) PRIOR ART

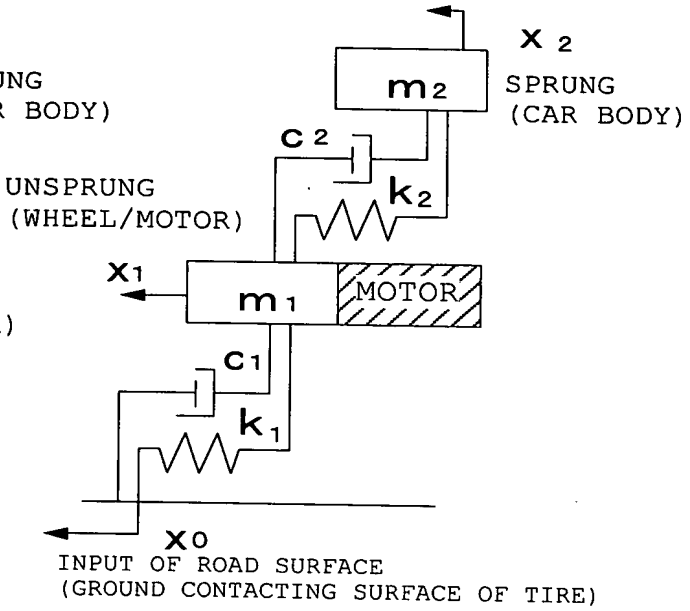


FIG.50 PRIOR ART

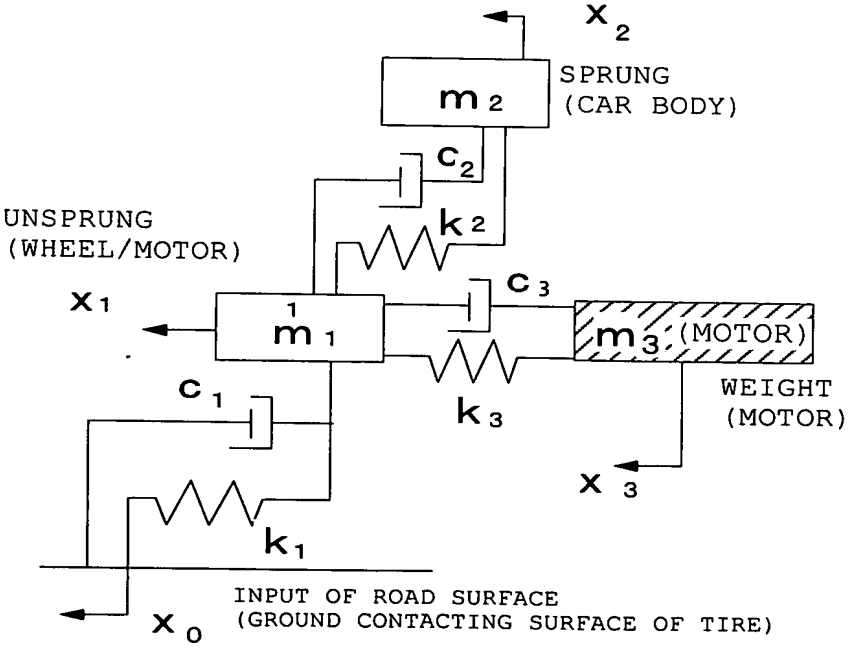


FIG.51

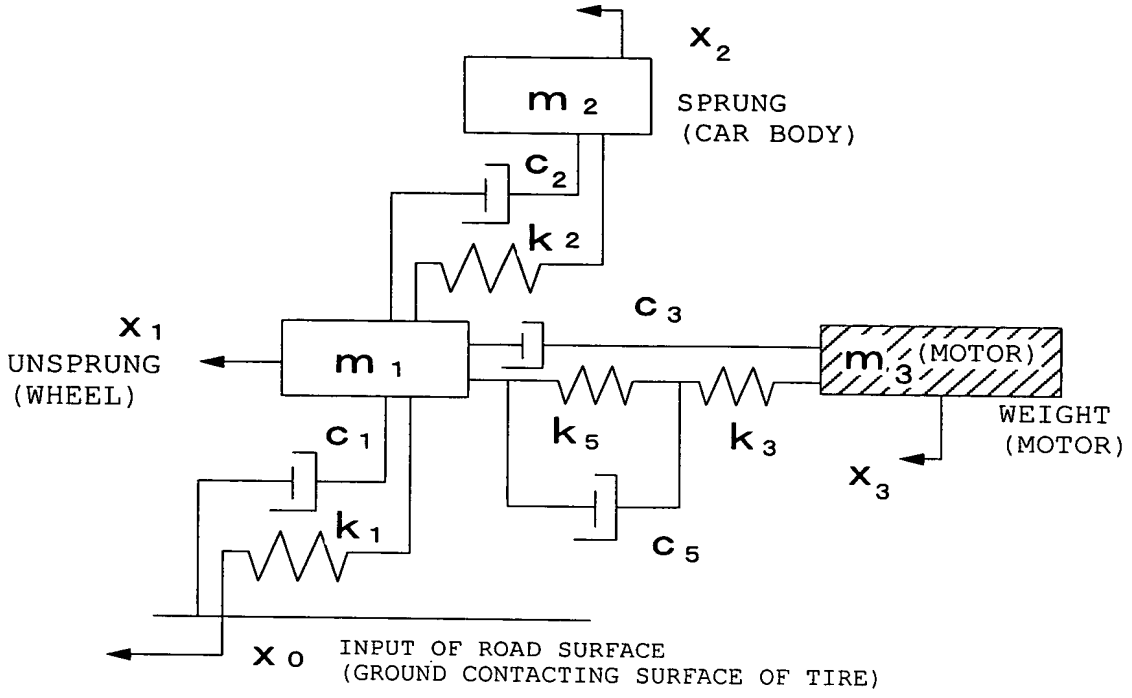

x2
m2
SPRUNG
(CAR BODY)
c2
k2
c3
x1
UNSPRUNG
(WHEEL)
m1
m3 (MOTOR)
WEIGHT
(MOTOR)
c1
k5
k3
x3
k1
c5
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.52

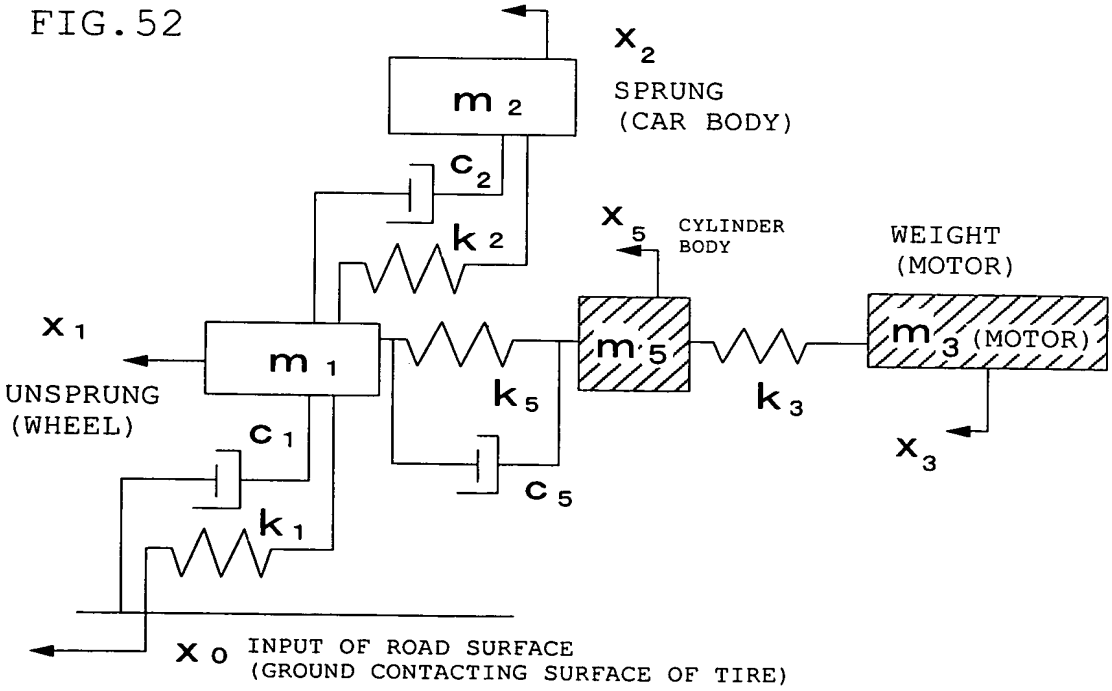

x2
m2
SPRUNG
(CAR BODY)
c2
x5
CYLINDER
BODY
WEIGHT
(MOTOR)
k2
x1
m1
m5
m3 (MOTOR)
UNSPRUNG
(WHEEL)
k5
k3
c1
x3
c5
k1
x0
INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.53

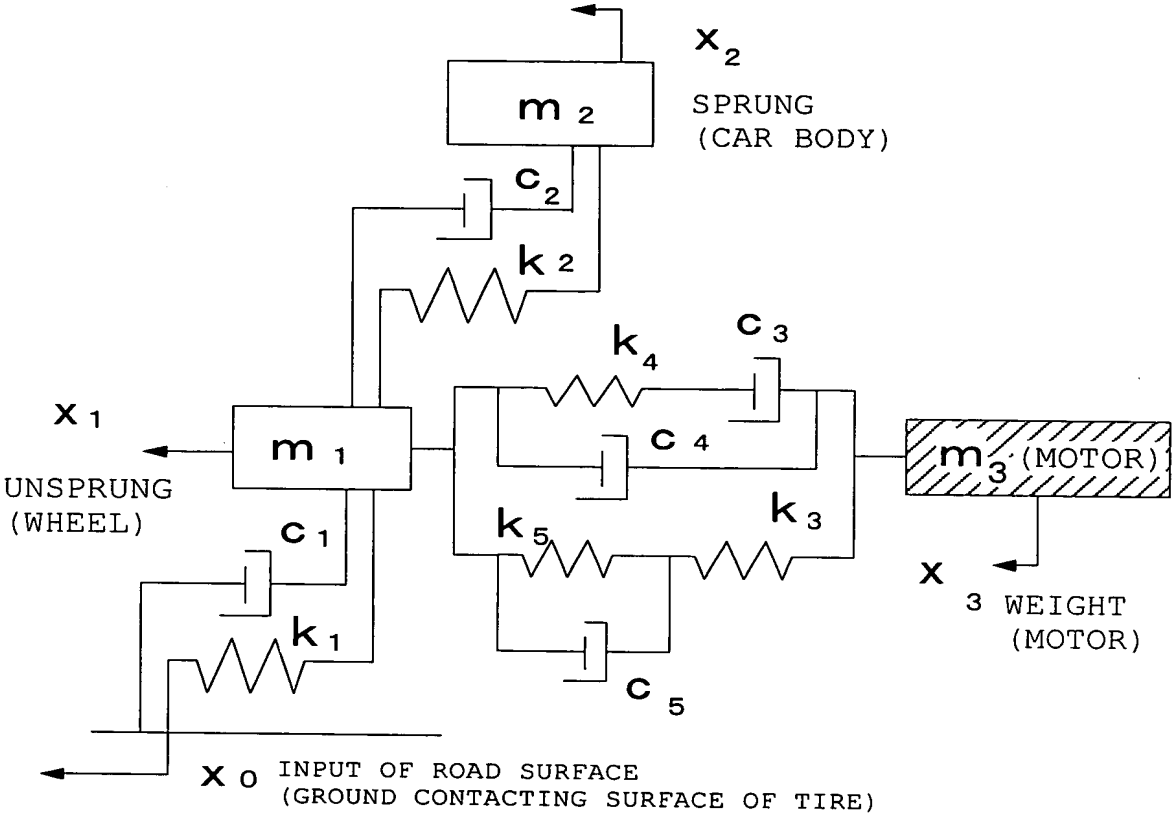

x 2
m 2
SPRUNG
(CAR BODY)
c 2
k 2
k 4
c 3
x 1
m 1
c 4
m 3 (MOTOR)
UNSPRUNG
(WHEEL)
k 5
k 3
c 1
x 3 WEIGHT
(MOTOR)
k 1
c 5
x 0 INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.54

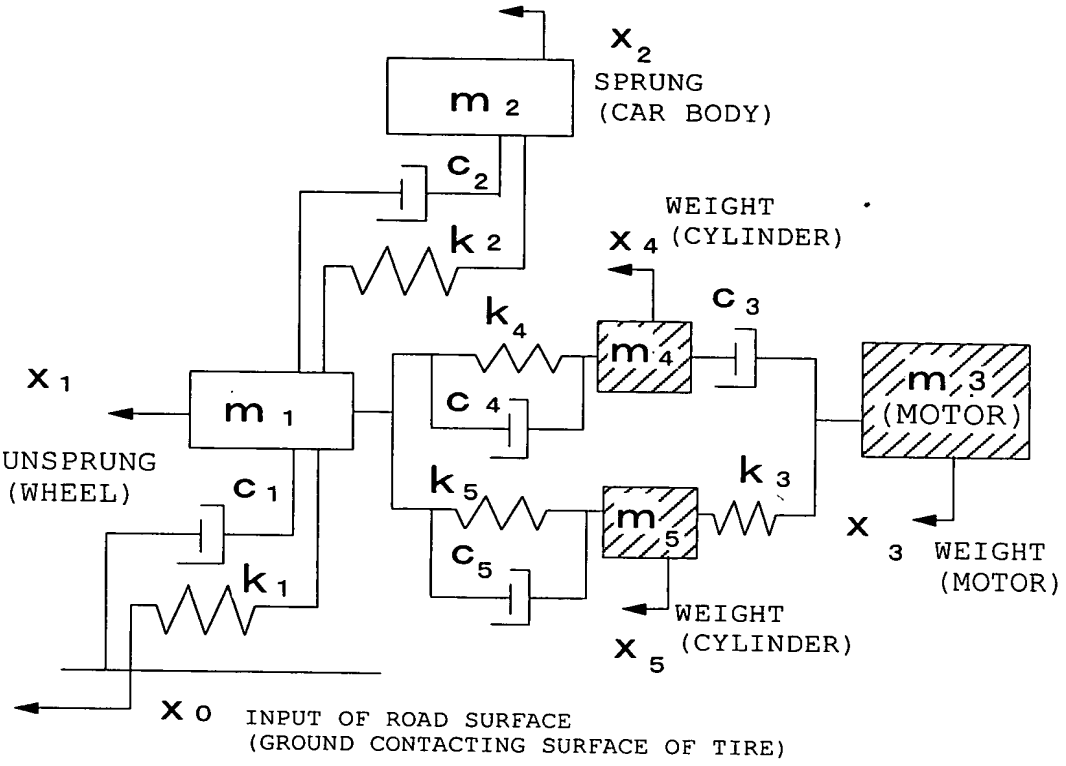

x2
m2
SPRUNG
(CAR BODY)
c2
k2
WEIGHT
x4 (CYLINDER)
k4
c3
m4
x1
m1
c4
m3
(MOTOR)
UNSPRUNG
(WHEEL)
c1
k5
k3
m5
x3 WEIGHT
(MOTOR)
c5
k1
WEIGHT
x5 (CYLINDER)
x0 INPUT OF ROAD SURFACE
(GROUND CONTACTING SURFACE OF TIRE)

FIG.55

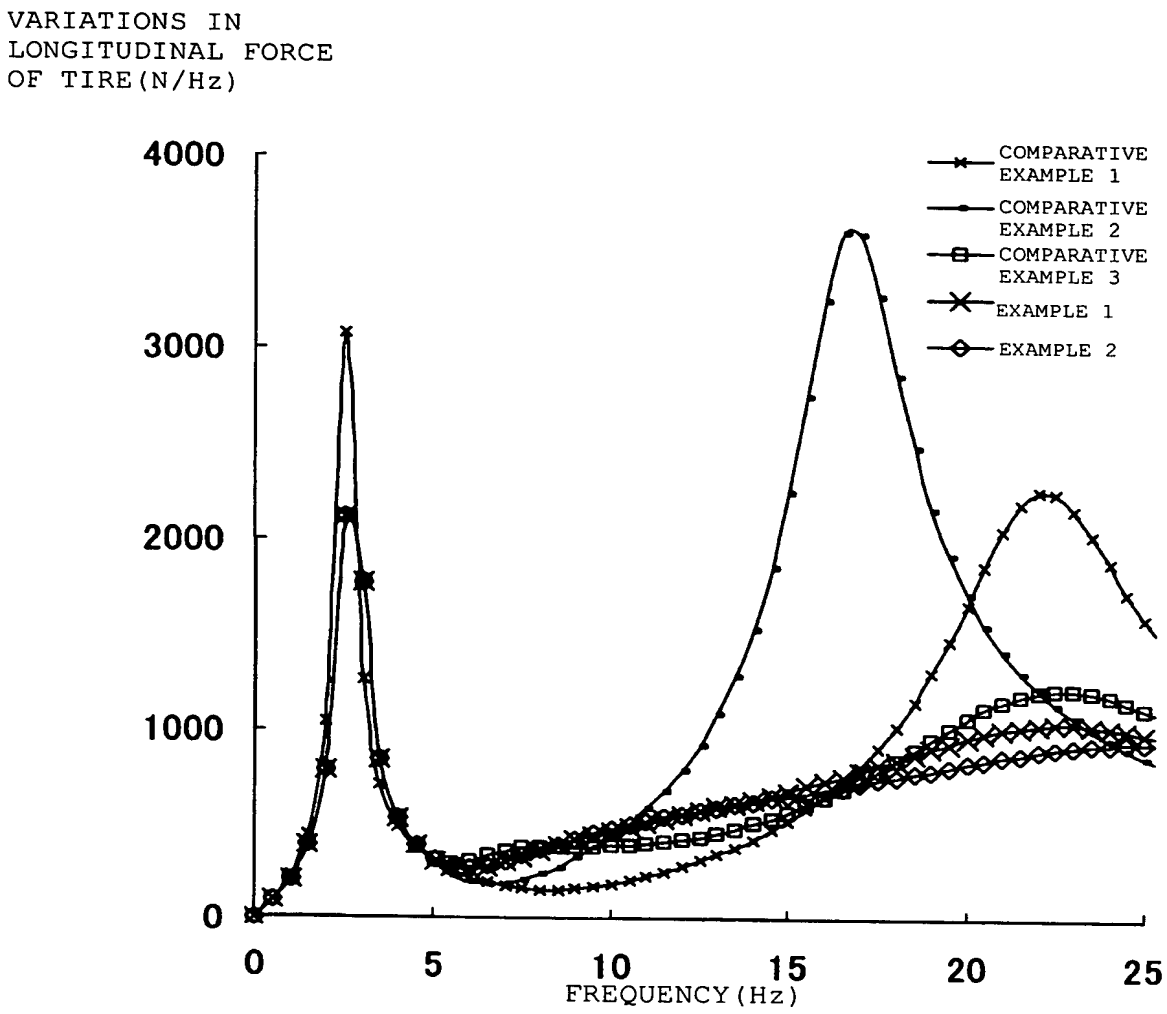

VARIATIONS IN
LONGITUDINAL FORCE
OF TIRE(N/Hz)
4000
3000
2000
1000
0
0
5
10
15
20
25
FREQUENCY(Hz)
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
COMPARATIVE EXAMPLE 3
EXAMPLE 1
EXAMPLE 2

FIG.56

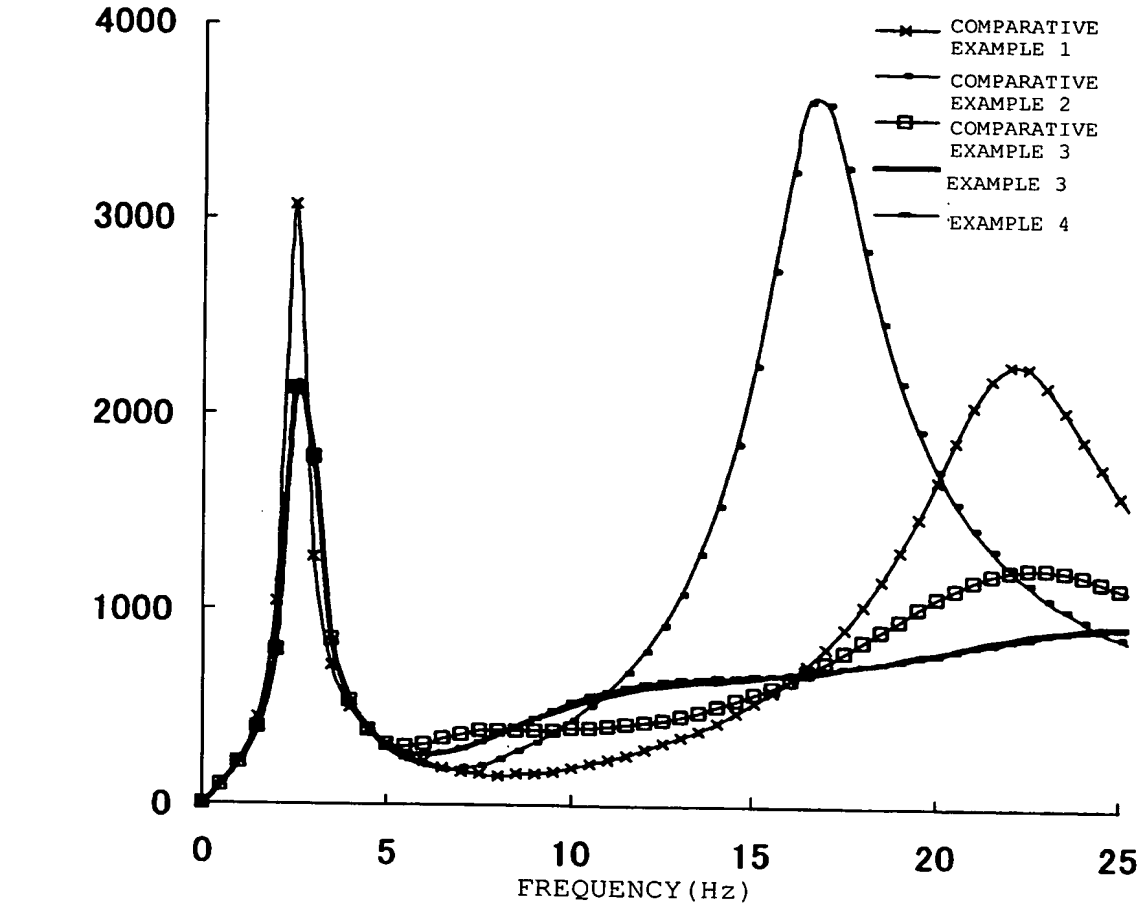

VARIATIONS IN
LONGITUDINAL FORCE
OF TIRE(N/Hz)
4000
3000
2000
1000
0
0
5
10
15
20
25
FREQUENCY(Hz)
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
COMPARATIVE EXAMPLE 3
EXAMPLE 3
EXAMPLE 4

FIG.57

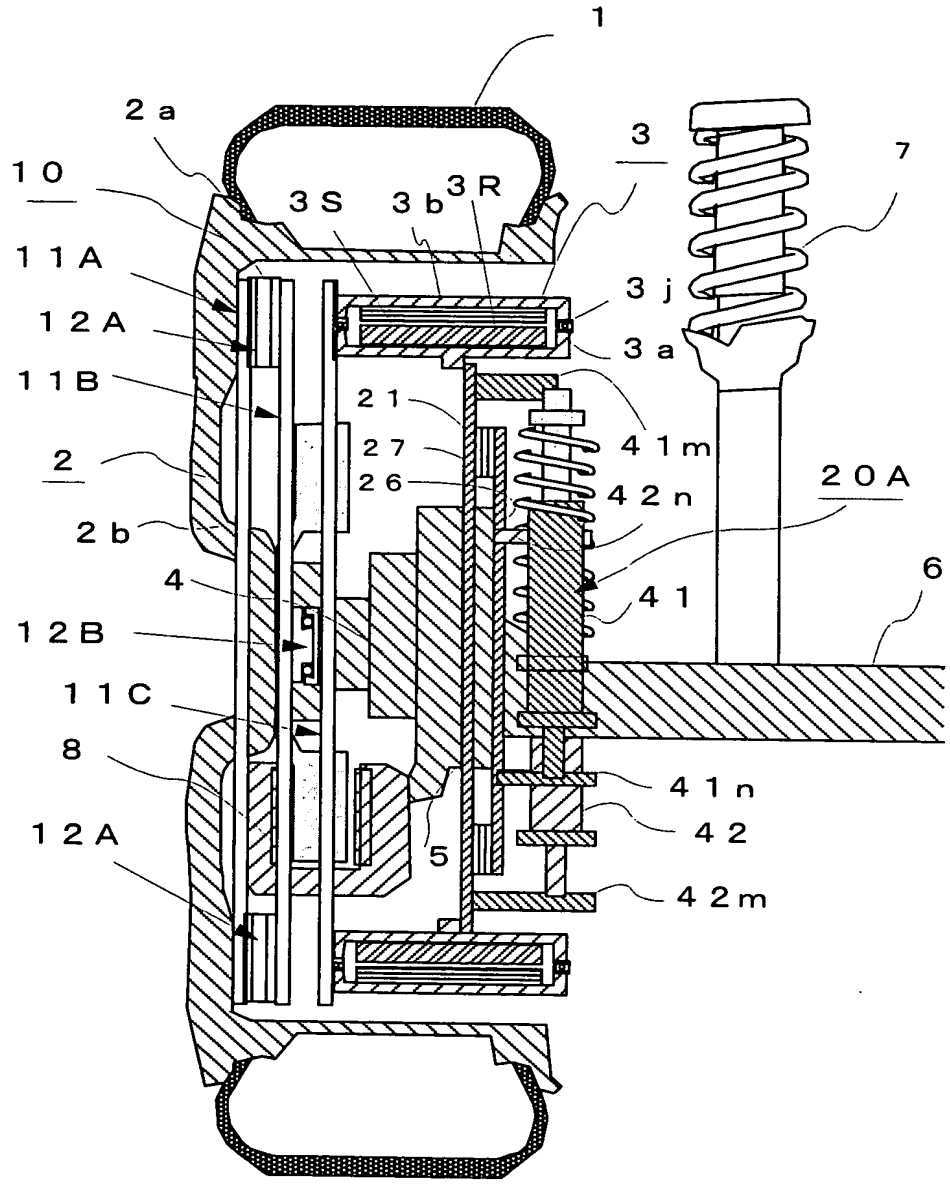

1
2a
10
3S
3b
3R
3
7
11A
12A
3j
3a
11B
21
41m
2
27
26
42n
20A
2b
41
6
4
12B
11C
41n
8
42
12A
5
42m

FIG.58

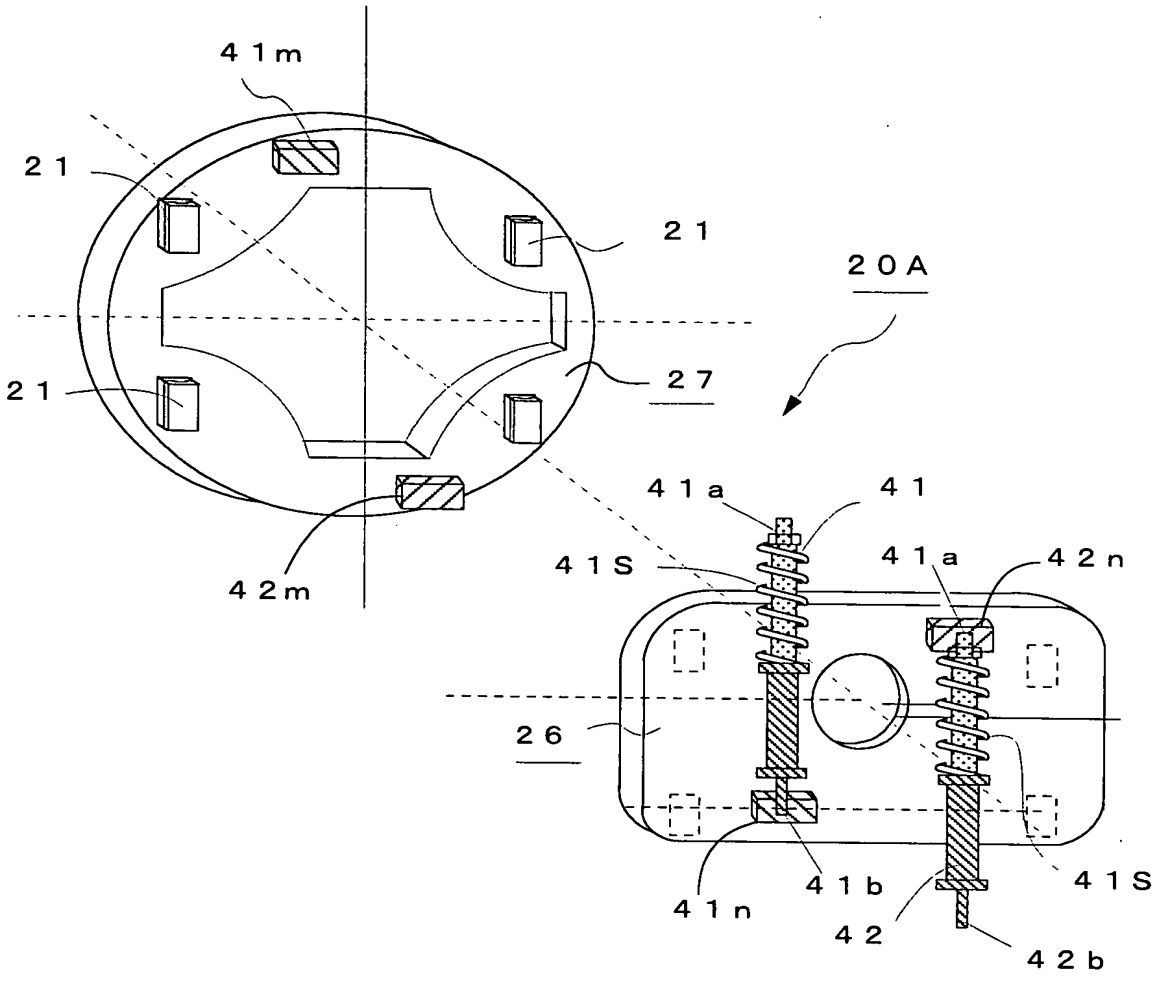


FIG.59

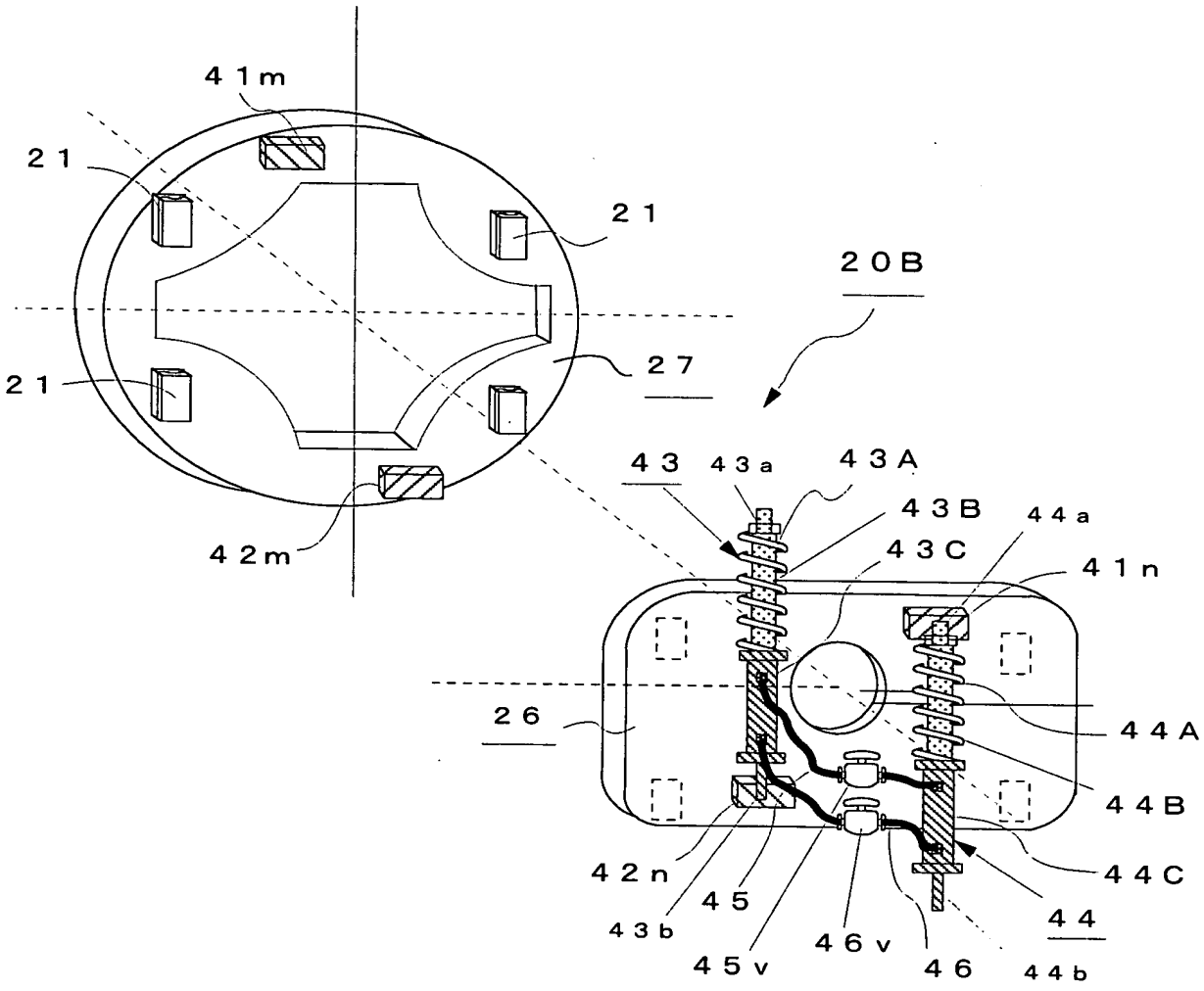

41m
21
21
21
27
20B
42m
43
43a
43A
43B
44a
43C
41n
26
44A
44B
44C
42n
45
43b
45v
46v
46
44
44b

FIG. 60

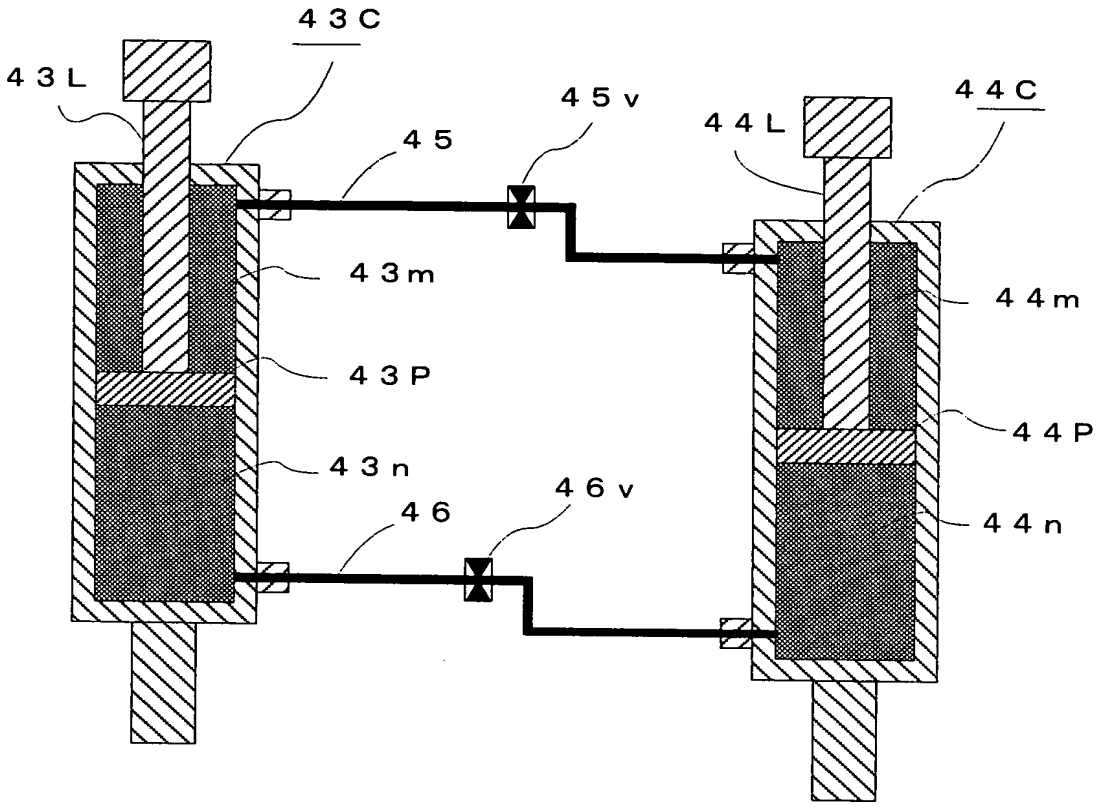


FIG.61

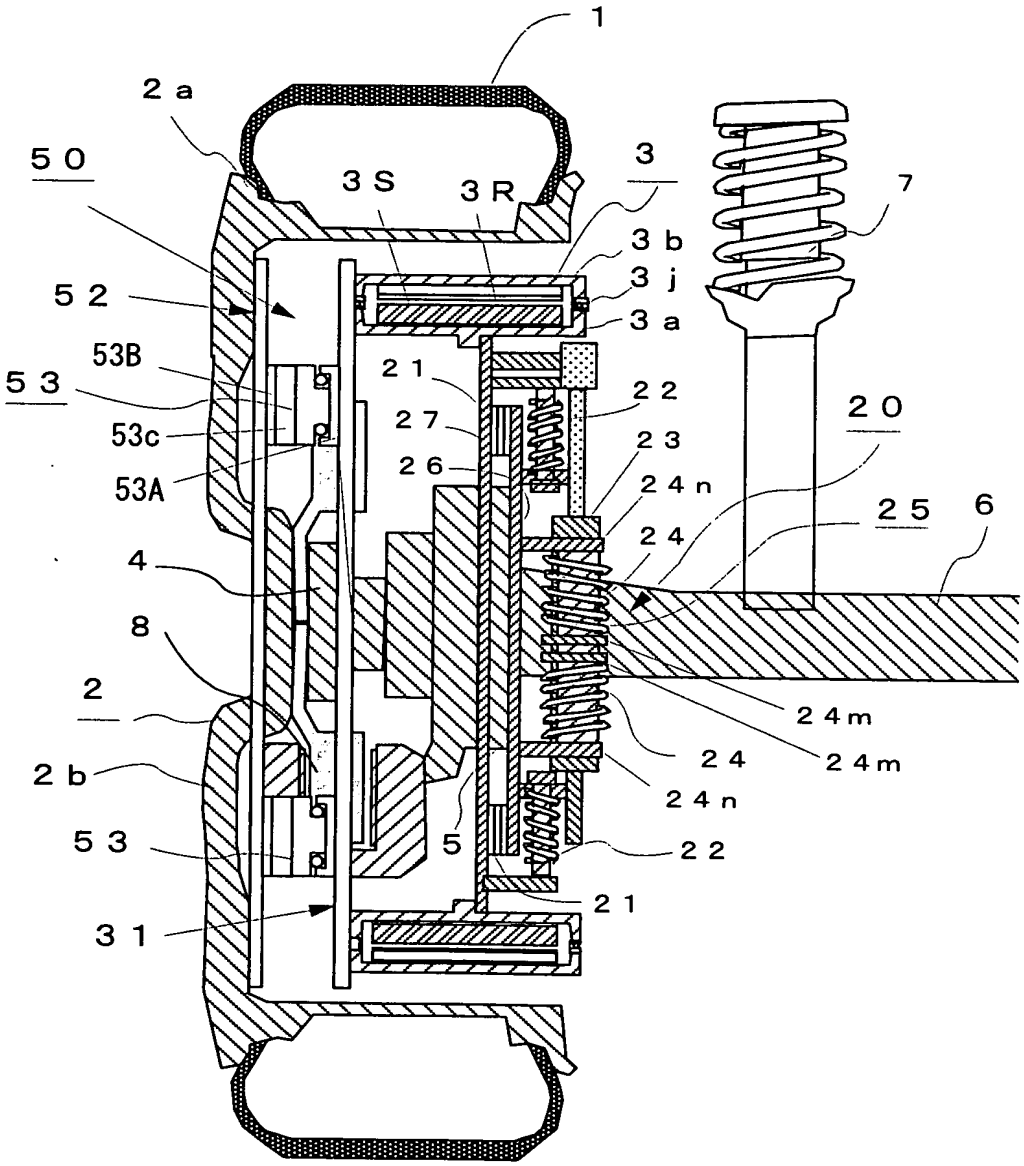

1
2a
50
3S
3R
3
7
3b
3j
3a
52
53B
53
21
22
27
23
53c
26
20
53A
24n
25
6
24
4
8
24m
2
24
24m
24n
2b
53
5
22
21
31

FIG.62

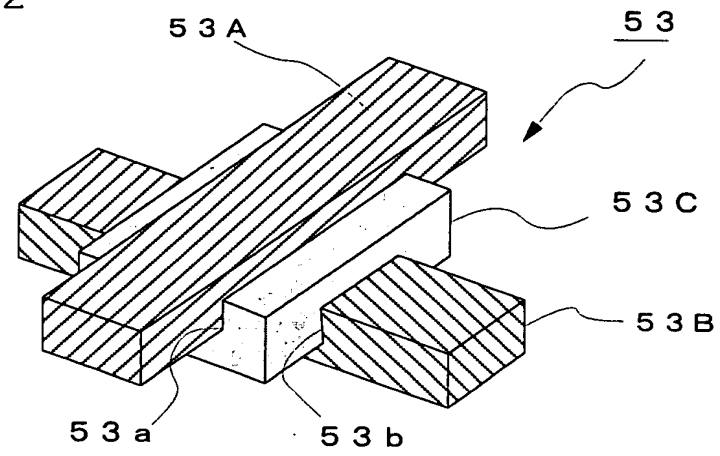

53A
53
53C
53B
53a
53b

FIG.63

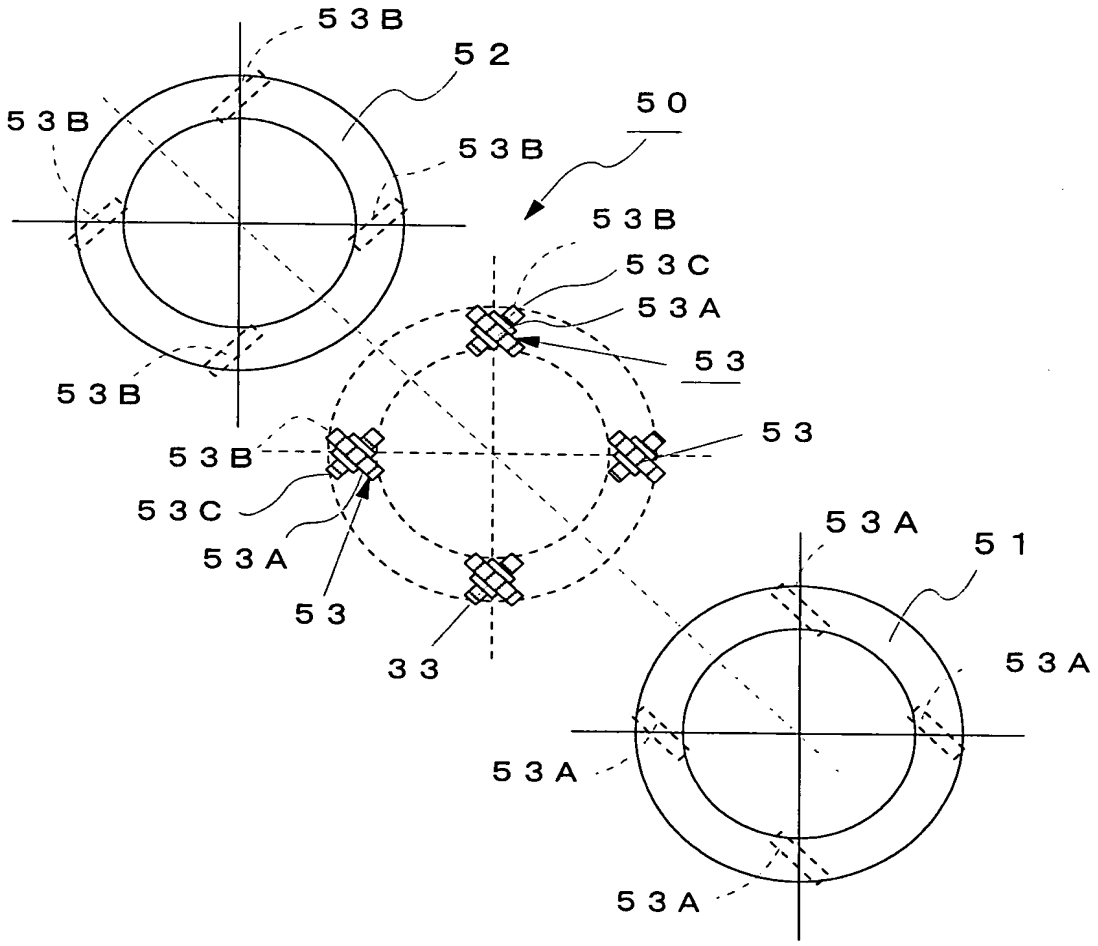

53B
52
53B
50
53B
53B
53B
53C
53A
53
53B
53
53C
53A
53
33
53A
51
53A
53A
53A

FIG.64

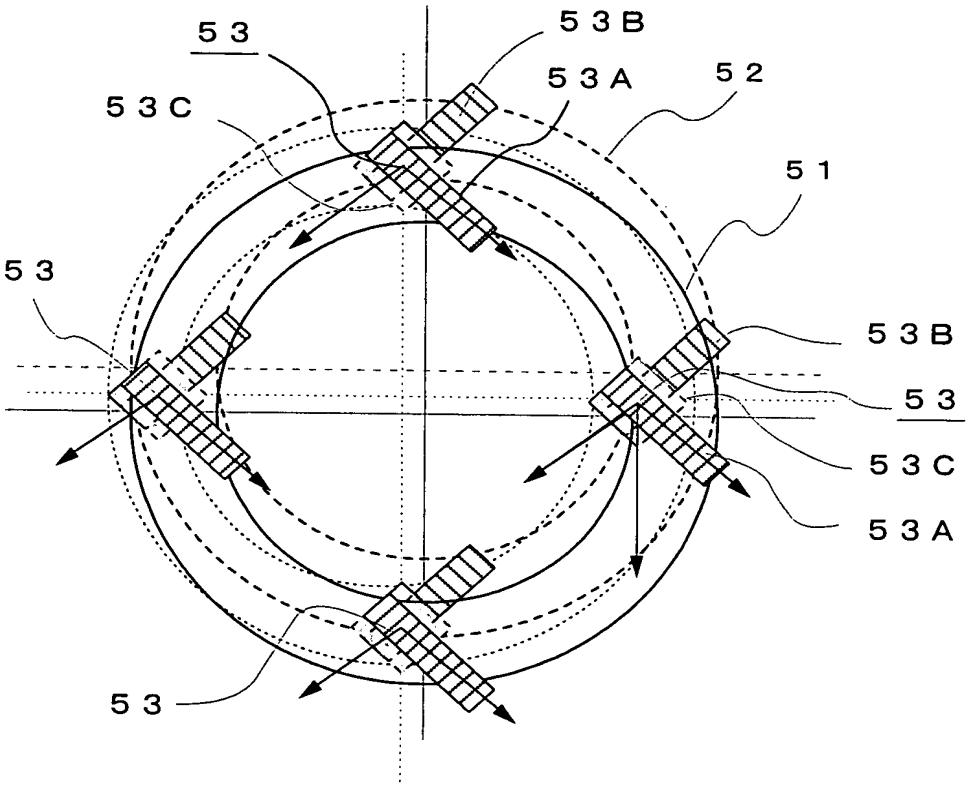


FIG.65

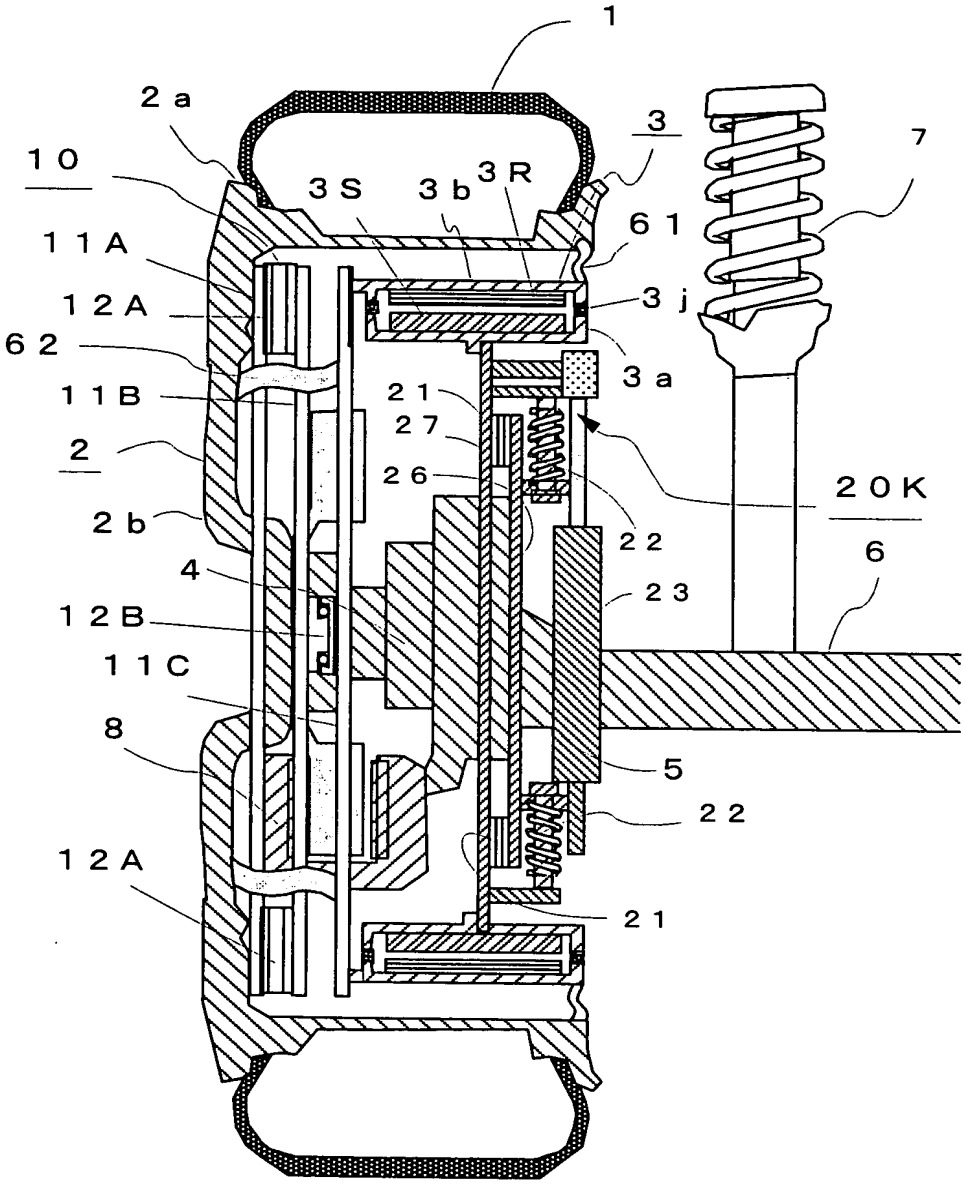

1
2a
10
3S
3b
3R
3
7
61
11A
12A
3j
62
3a
11B
21
27
2
26
20K
2b
22
6
4
23
12B
11C
8
5
22
12A
21

FIG.66

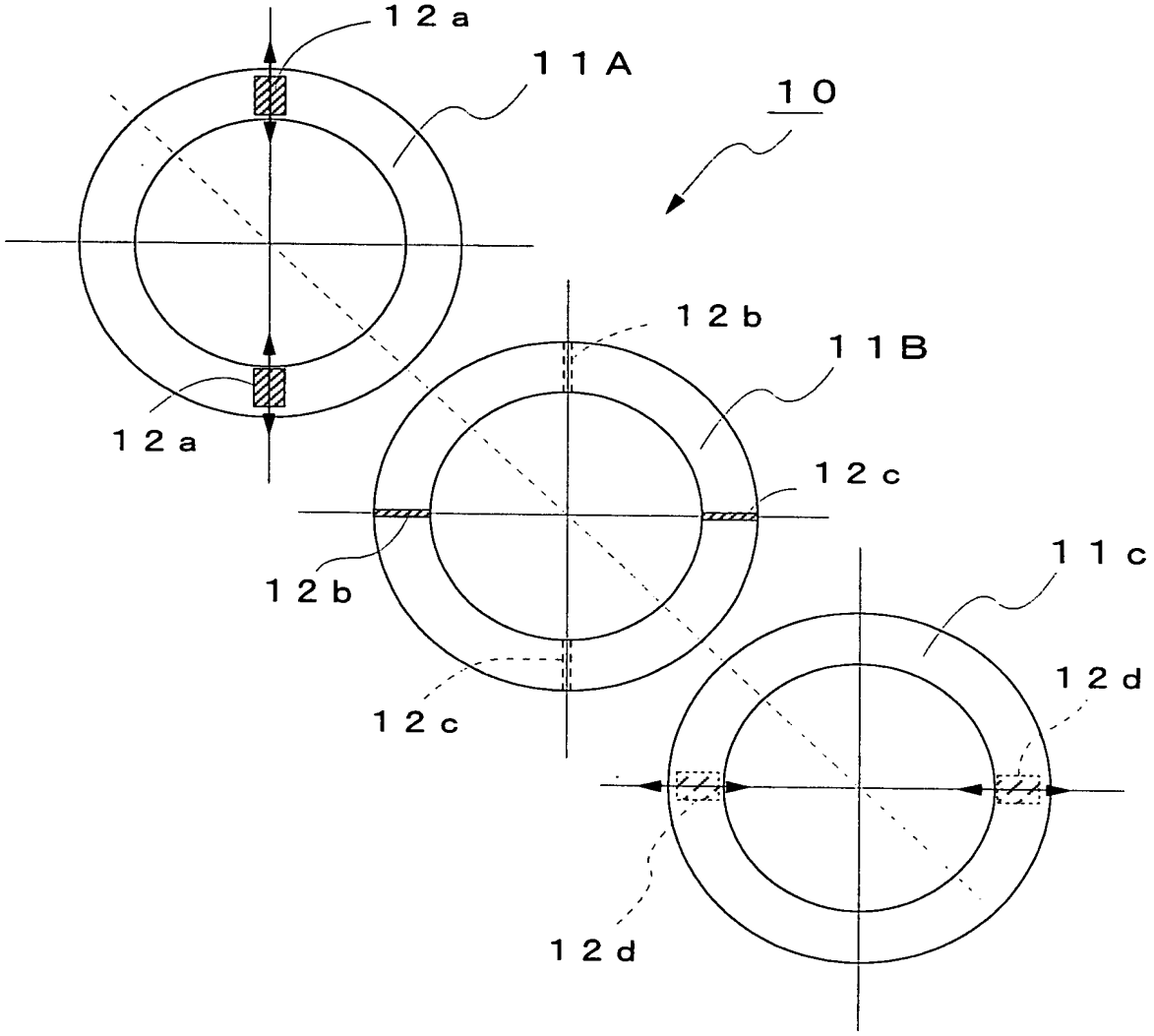


FIG. 67

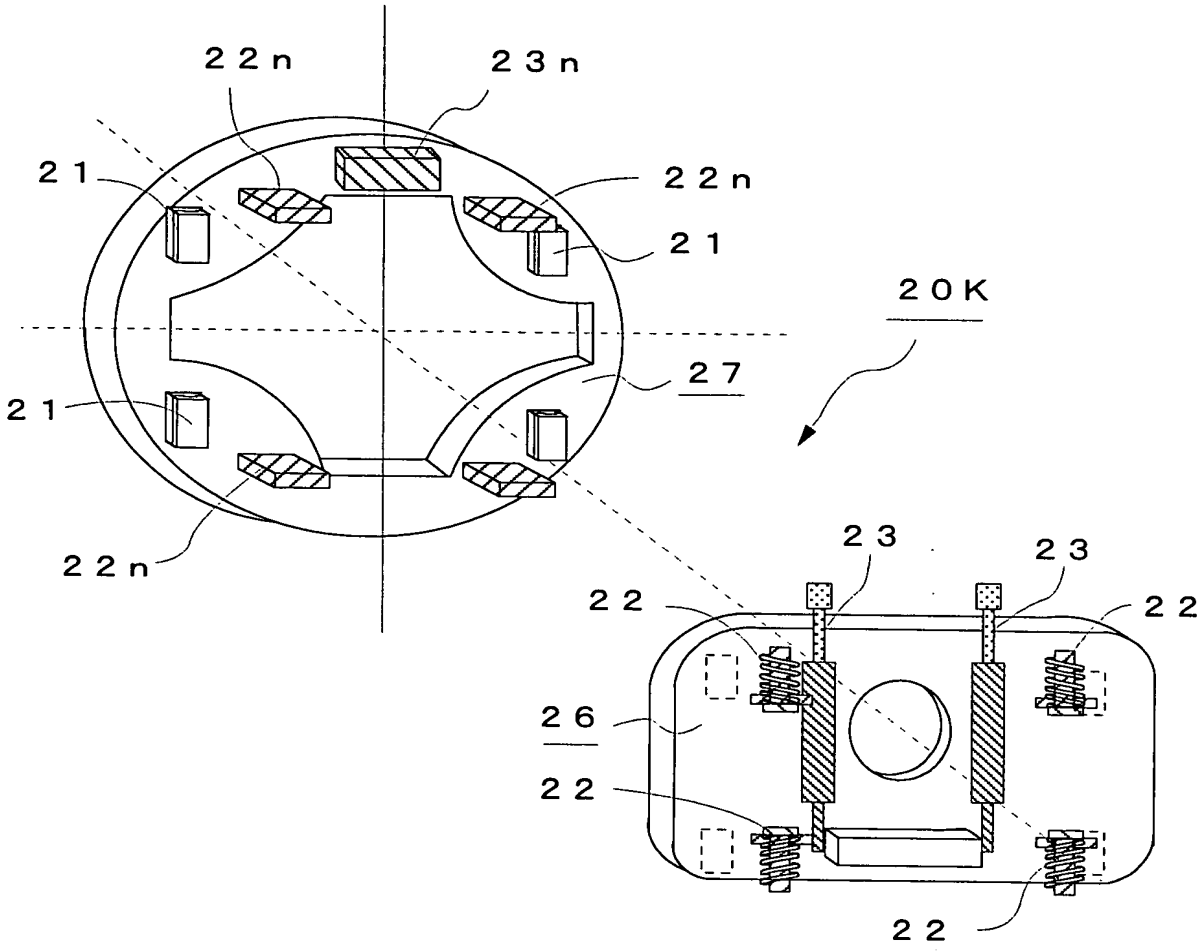


FIG.68

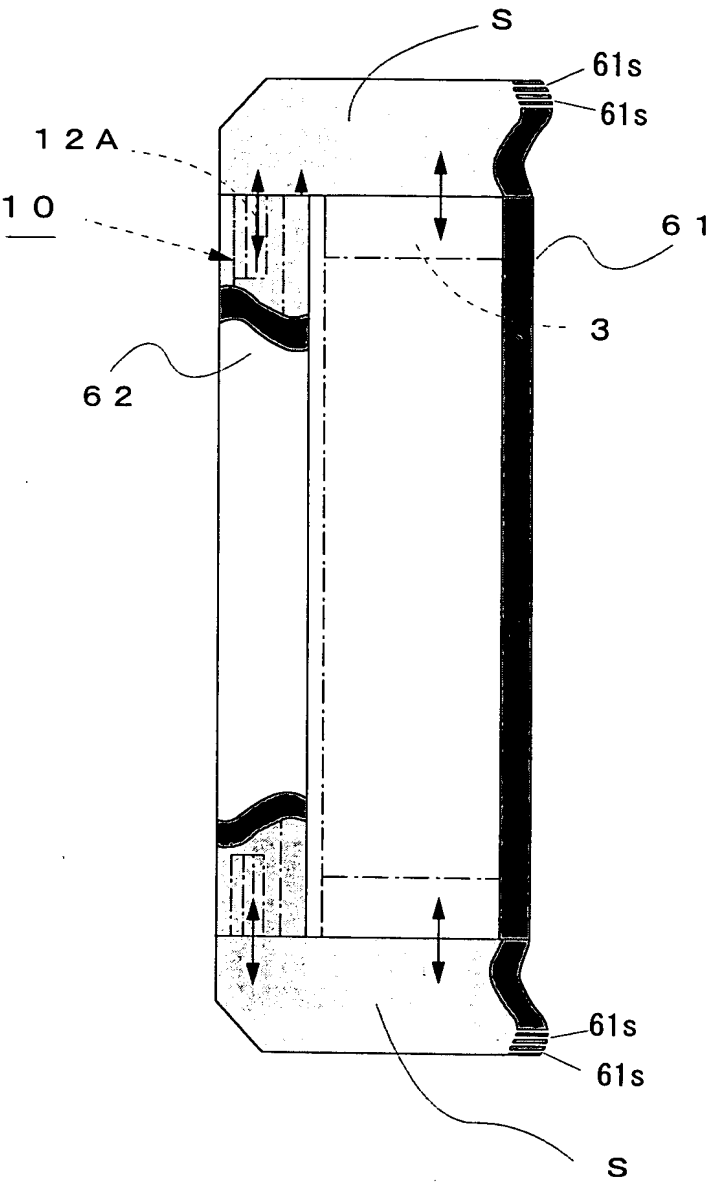


FIG.69

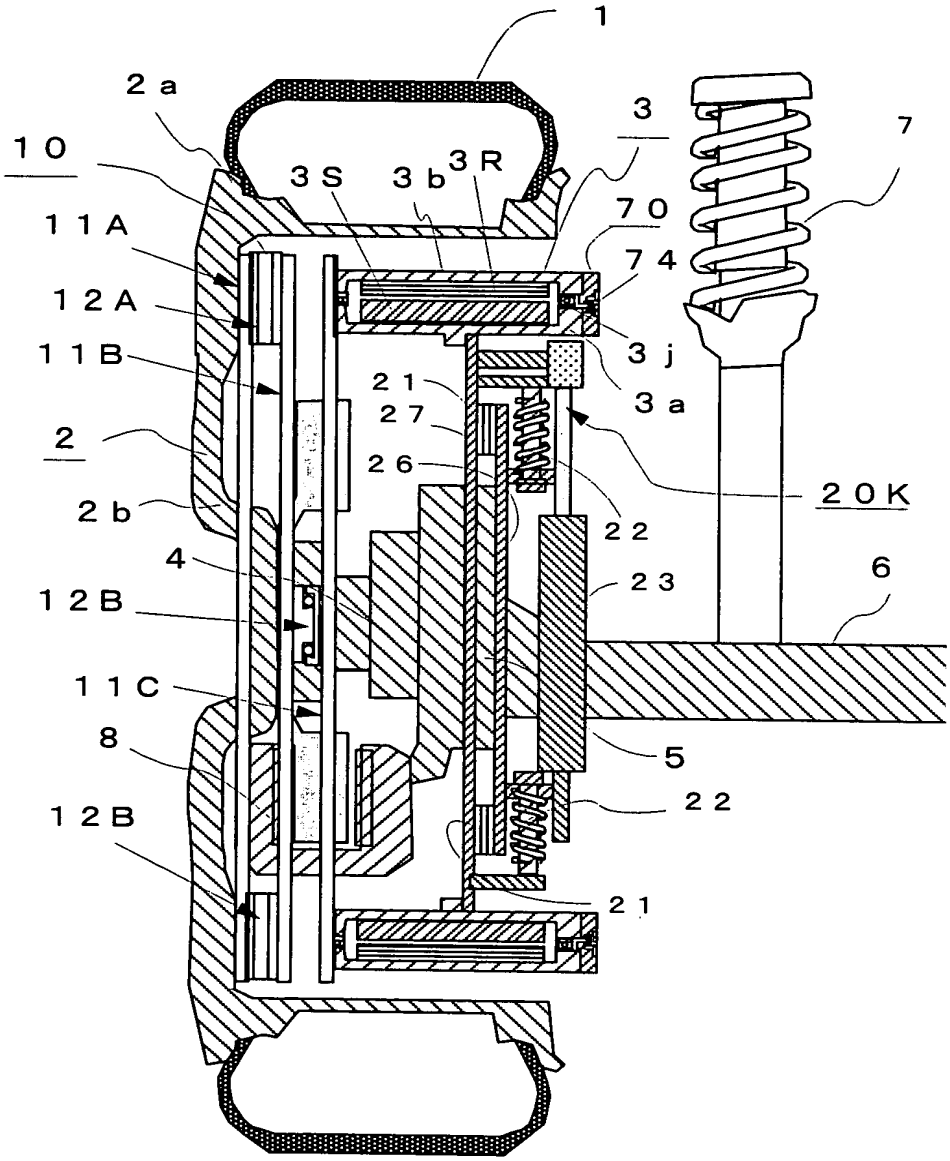

1
2a
10
3S
3b
3R
3
7
70
74
11A
12A
11B
3j
3a
21
27
2
26
20K
22
2b
4
23
6
12B
11C
5
8
22
12B
21

FIG.70

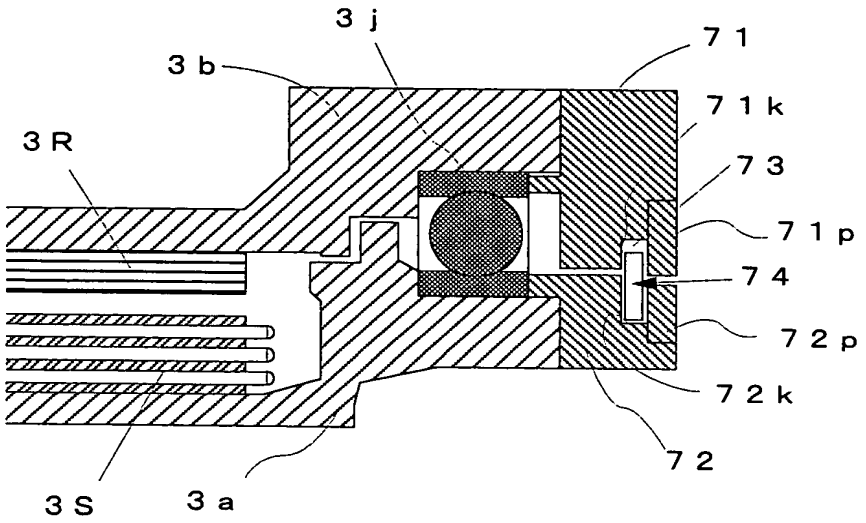


FIG.71(a)

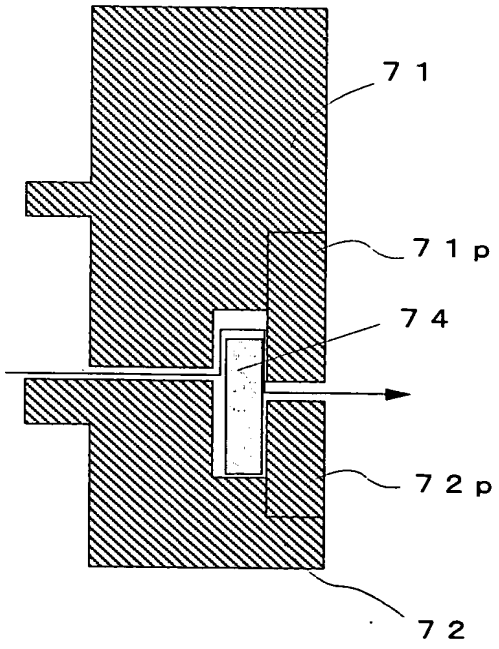


FIG.71(b)

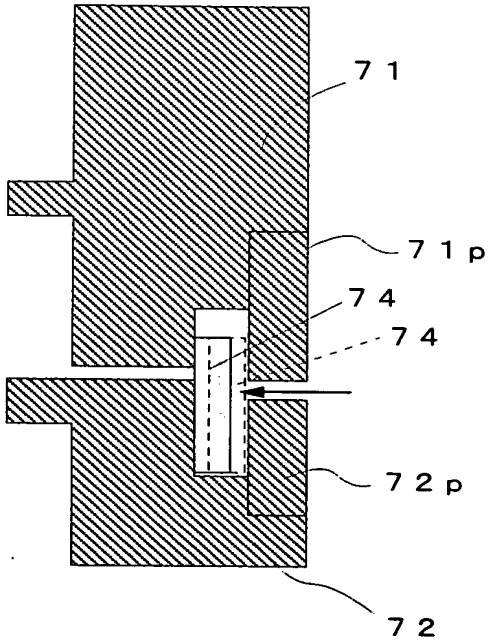


FIG.72 PRIOR ART

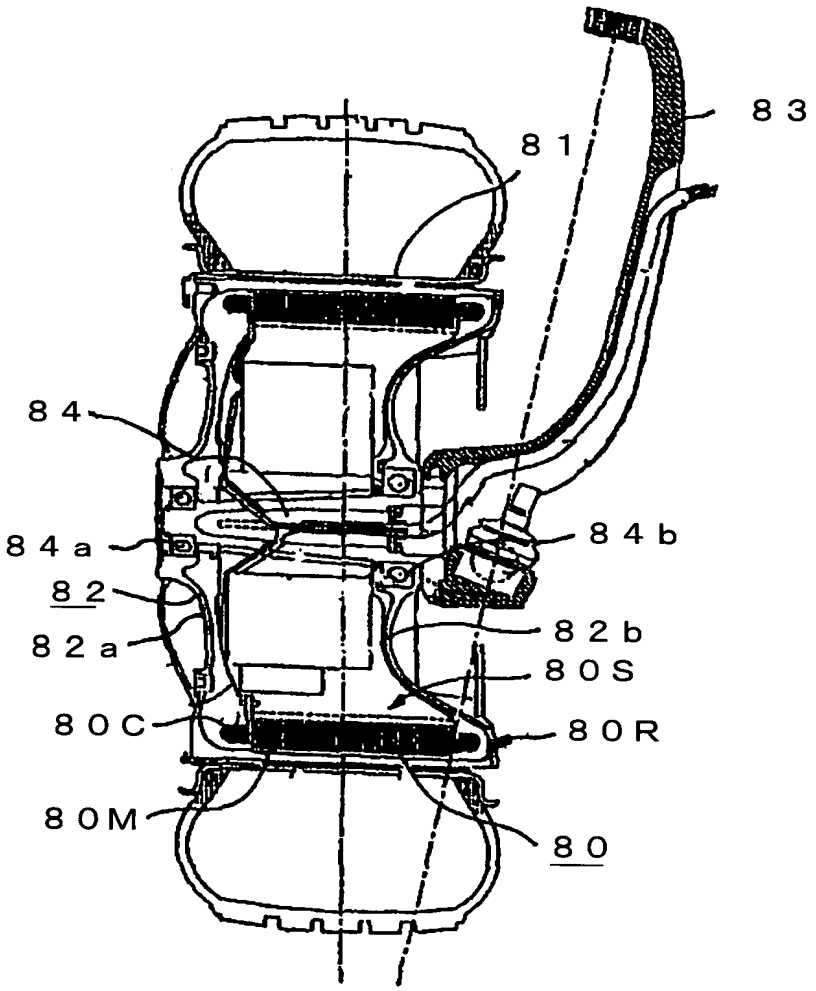


FIG.73 PRIOR ART

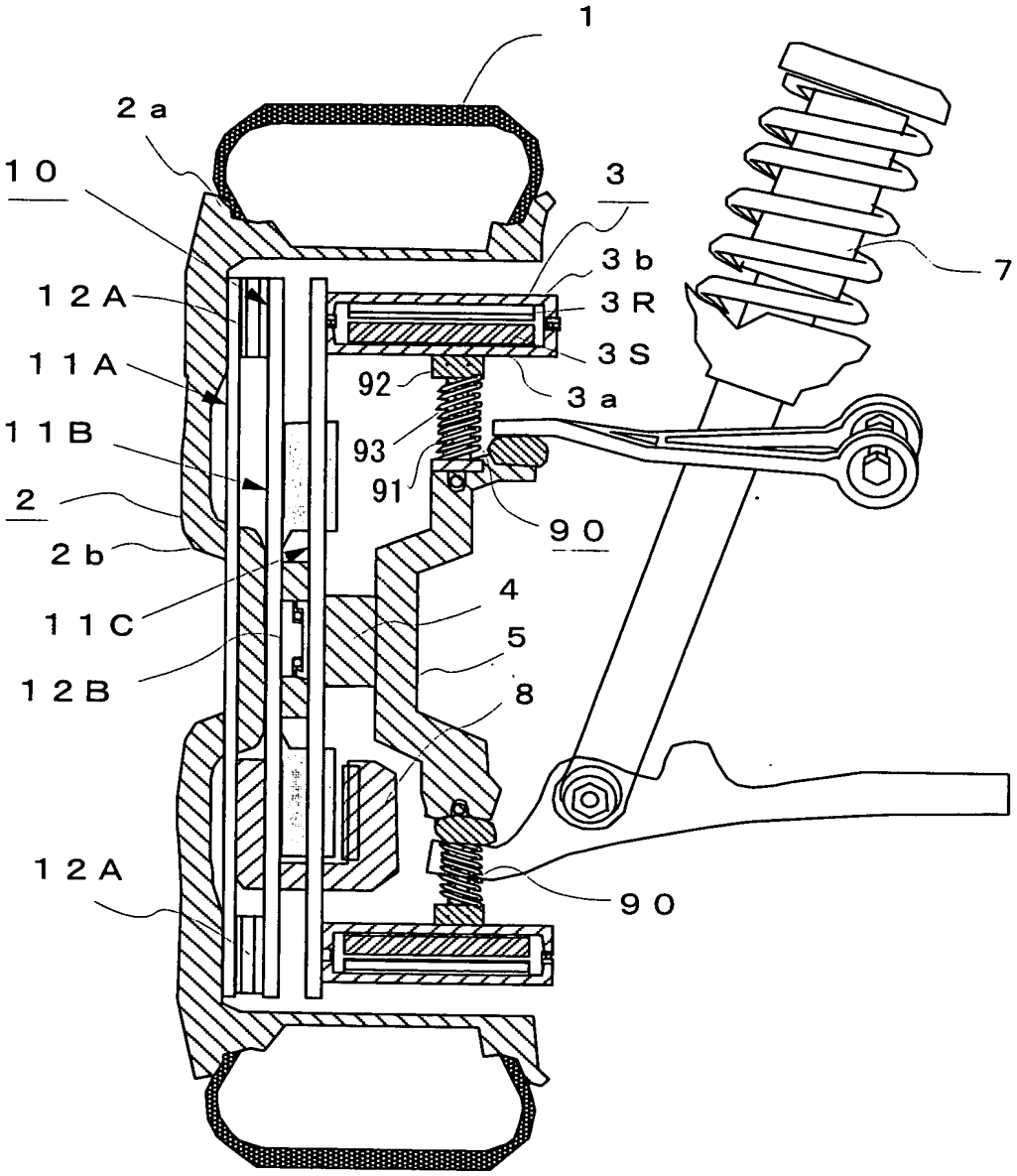


FIG.74 PRIOR ART